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MACHINERY

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VOLUME 29 **MACHINERY** NUMBER 12

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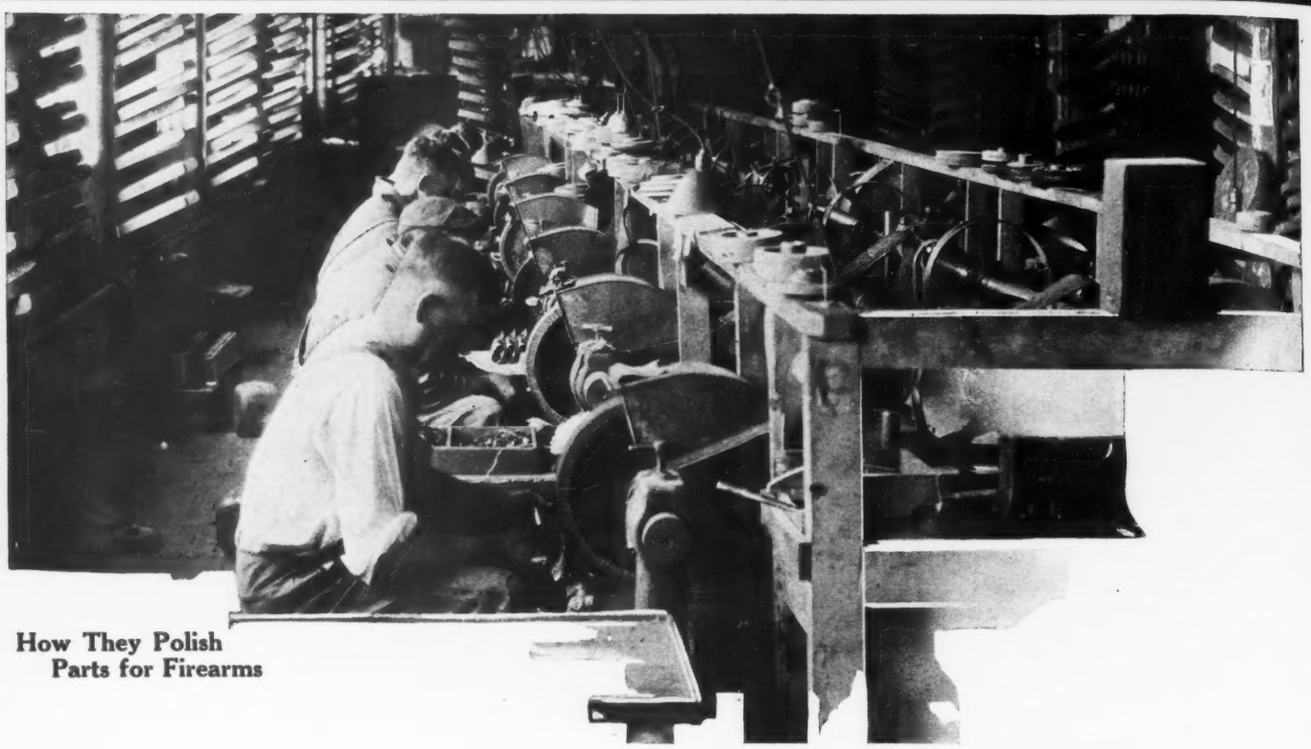
A Locomotive Testing Laboratory, Running-in Tests for Machine Tools, Polishing of Firearm Parts, Special Machines in a Typewriter Plant, and Draftsmen's Training, are some of the subjects dealt with in September MACHINERY.

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A Few Words About



How They Polish Parts for Firearms



An L. C. Smith Typewriter in Action

The present opportunity for inventive genius and the value of a thorough mechanical education are particularly stressed in September MACHINERY. The following quotations from two articles which will appear in September open a line of thought that leads far.

"Inventive Genius," says Carl Gabrielson, of the L. C. Smith Typewriter Company, "has a greater opportunity in the development of special metal working machines, intended for single purpose operations, than it has in the design of more or less standard machine tools"—

And Donald A. Nevin, tool designer, in the article "The Mechanical Education of a Draftsman," says this—"The most common deficiency among younger draftsmen is the lack of a thorough mechanical education. This is due not so much to the lack of opportunity for instruction as it is to failure to take advantage of the valuable opportunities that are offered for acquiring additional education"—

A Timely, Interesting,

Studying Mechanisms in Motion



Application of an Optical-Mechanical Apparatus for Studying the Action of Rapidly Moving Parts

By PETER DAVEY

THE action of a mechanism operating at high speed often varies from the normal action due either to lack of balance or to some other defect. When such a condition exists, the effect of improper functioning usually is evident, but the cause is frequently unknown. The principal difficulty in detecting such mechanical defects has been due to the impracticability of observing the action of rapidly moving parts. An ingenious apparatus, known as the Elverson oscilloscope, provides a means of studying various forms of high-speed mechanisms under actual working conditions, by apparently slowing or entirely discontinuing the movements, even though the parts under observation are operating very rapidly. As this apparatus has been described previously in the technical press, the article to follow will deal principally with its practical application.

Briefly, the oscilloscope consists of an electrical interrupter which is driven direct from a shaft of the mechanism under examination for the purpose of synchronizing the flashes of a special type of lamp with the moving part, so that when this part is seen under the rays of the lamp, its motion appears to be either greatly retarded or entirely discontinued. In Fig. 1 the electrical interrupter is shown attached to the rear end of a milling machine spindle. If the switch plate of the electrical interrupter is in the "stationary position," the lamp flashes are accurately synchronized with the moving part, which is illuminated instantaneously and repeatedly at the same point in its travel; consequently, it appears to be stationary, because it is only illuminated at the instant of passing this given position. If the observer desires to see the motion reproduced slowly, the switch plate is turned to the "creeping position." Then the successive lamp flashes are not quite in synchronism with the moving part, which is illuminated at points varying slightly and progressively. The result is that the part appears to be moving slowly.

The rapid succession of the lamp flashes causes what is known as "persistence of image" in the eye, with the result that a continuous picture is produced of the slowed down or arrested motion in the same way that the "movie" projector throws a series of rapidly succeeding pictures on the screen, which appear continuous to the eye. In the case of the oscilloscope, however, the actual mechanism is examined and not a picture of it. In order to produce a sharply defined image, it was necessary to evolve a lamp giving a flash of extremely short duration, and this has been achieved to such an extent that, when a machine running at high speed is viewed in the "stationary" position, it is difficult to imagine that it is not at rest.

When the action of a machine is to be observed, the only preparation necessary is to make a simple adapter to act as a coupling between the shaft of the machine and that of the oscilloscope gear-box. This gear-box, which is encircled by a special clip having provision for anchorage to prevent rotation, is attached to the adapter so that its primary shaft rotates with the shaft of the machine. Electrical connection is then made between the gear-box and lamp, and the case that contains the electrical equipment, including a storage battery which supplies the necessary current for operating the lamp. These connections are effected by plugs and sockets, and long leads are provided so that the case may be moved out of the way, and the lamp carried around and used to illuminate any part of the machine. When not in use, the lamp and gear-box fit into the case, making a portable outfit. Given a rotary drive for the gear-box, the oscilloscope may be employed for the examination of any type of motion, either rotary or reciprocating, in cams, gears, chains, friction drives, slipping clutches, etc. This instrument has been developed by Herbert Kennedy & Co., Ltd., 233 Broadway, New York.

In addition to the "creeping" or "stationary" positions which are controlled by the gear-box switch, the action of a given part in different phases or positions may be observed by turning the complete gear-box around on the shaft. A protractor scale is mounted around the outer face of the box, from which accurate angular measurements of the degree

This article describes the practical application of a device known as the "Oscilloscope," by means of which it is possible to observe the action of high-speed mechanisms under actual working conditions. With this device, the action of the mechanism, moving at high speed, may be studied as if it were moving very slowly or actually standing still. This is accomplished by the use of a special type of electrical lamp, the flashes of which are synchronized with the movements of the revolving mechanism. If the lamp flashes illuminate the moving part repeatedly at the same point in its travel, it will appear stationary, because it is illuminated only at the instant when it passes a given position. If the successive flashes of the lamp illuminate the moving part at points slightly in advance of each other, the result will be that the part will appear to be moving slowly.

of alteration of the phase may be read off. Thus, for instance, the period of operation of a cam may be measured under actual working conditions when lag is occurring due to the effects of inertia.

In this case, the oscilloscope is switched to the "stationary" position, and the cam mechanism illuminated by the lamp; the gear-box is then revolved slowly by hand, and at the point where the follower begins to rise, the angular measurement on the scale is noted. The gear-box is next revolved further, while the cam is seen to complete its cycle of operations, and at the point where the follower finally reaches the neutral section of the cam, the angular measurement shown on the scale is again noted. Now by taking the difference between the two readings, the true period of operation of the cam is determined under working conditions. At any point in the cycle, linear measurements also may be taken of the lift of the follower, and these linear measurements plotted against the angular measurements, thus giving a complete graphical record of the working of the cam. In some cases, curves taken in this way have shown astoundingly divergent results from the theoretical curves.

Observation of Gearing

Much valuable information has been gained about running gears, by studying the teeth meshing under actual working conditions in order to observe lost motion, lubrication, etc. A point that is often missed in this connection is the manner in which the gears are mounted, and there is no doubt that much time has been wasted in attempting to rectify the cutting of gears, when in reality the trouble has been that their mountings were not correct.

The oscilloscope may be successfully applied in many such cases, by making analyses of the vibrations around the bearing, and investigating the state of alignment when running, as well as the twist and whip in shafts. It can easily be seen whether or not the lubricant is doing its proper work, and in many cases it has been proved that oil, though supplied in quantities seemingly in excess of requirements, has been thrown off so that there was no oil at the essential point, namely, the point of contact of the teeth, although when viewed by the naked eye it seemed that correct lubrication was being effected. These statements also apply to chain drives, and chains often show vibrations that throw much light on the question of excessive wear and noise.

Action of Lubricants

The general subject of lubrication probably presents to the engineer more unexpected phenomena, when observed by the oscilloscope, than any other. This is explained by the fact that there are so many factors governing the behavior of the lubricant on high-speed moving parts as, for instance, the grade of lubricant; the nature of the surface on which it flows; the angle at which it strikes the moving parts; the nature of the oil supply, whether drip, splash, or continuous jet; and the surrounding temperature conditions. If we add to these the varying forces that act on the lubricant, such as surface pressure, centrifugal force, and supply pressure, it is not surprising that slight variations of any of these conditions should produce a great variation in the efficiency of lubrication.

Under the rays of the oscilloscope lamp it is a simple matter to observe exactly the formation of oil globules, their direction of flow, and the points from which they are thrown off the moving parts; and such observations have often led to improved economy in oil consumption, or by the slight alteration of small details, to the effecting of correct lubrication from conditions that otherwise produced practically no lubrication.

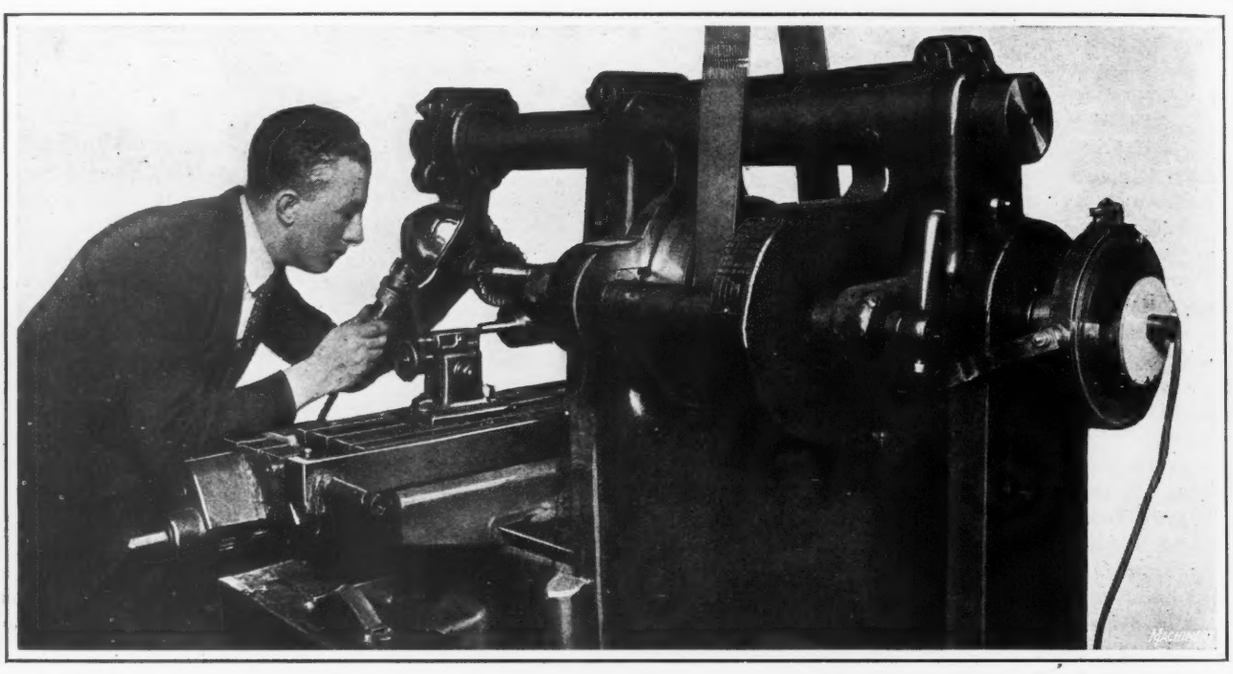


Fig. 1. Oscilloscope applied to a Milling Machine for observing Action of Milling Cutter

Studying Actions of Manufacturing Operations and Cutting Tools

Certain applications of the instrument have led to considerable speeding up of production operations, especially on high-speed automatic machinery, where it has shown the effect of running the machine in excess of normal speed, and by a close study of the defects that develop under these conditions has made clear the means of overcoming them, and thus making it possible to raise the normal speed. In many manufacturing operations, it is necessary either to run machines considerably below the maximum speed, or to stop them at regular intervals in order to inspect the progress of the work, and thus avoid the scrapping of a large batch of output through inability to check the setting of the machine while it is running. The oscilloscope provides a means of making the work appear as if it were creeping slowly through the machine, or else standing still at any particular point in the operation, and thus any fault developing under working conditions may be noted immediately, and it will never be necessary to stop or slow down the machine until such a fault does occur.

Study of the exact action of a cutting tool throws much light on the question of poor quality work or rapidly wearing tools (see Figs. 1, 2 and 3.) The cause and extent of chatter may be closely examined, and the point at which increased rigidity is desirable, to assist in its elimination, can be detected. In choosing the correct shaped cutter for a particular grade of material, it is of great value to be able to ascertain the form of shaving for different cutting depths and feeds; by watching the cutter, each stage of the cut of any individual tooth can be followed, and some very interesting results have been produced by the observation of a series of cutters, each ground in a slightly different way.

Determining the Periodicity of a Vibration

In the case of vibrations, special provision is made for their complete analysis, as regards direction, periodicity, and amplitude, and to attain this it is possible to produce either one, two, or four flashes per revolution of the shaft, in either the "creeping" or "stationary" position. Under ordinary circumstances the moving parts are illuminated by one flash per revolution of the shaft driving the oscilloscope.

Now suppose we consider a vibrating part viewed in the "creeping" position on one flash per revolution; we shall see the vibration slowed down, when it will appear as a slow swaying to and fro of the vibrating part. Assume that the vibration is occurring at shaft speed; then if we adjust the gear-box to cause the lamp to flash twice per revolution in the "creeping" position, two views of the vibrating part will be seen, 180 degrees apart, and this phenomenon will appear as two images of the part periodically approaching and receding from each other. Similarly, four flashes per revolution, in this case, would produce a quadruple image of the vibrating part, but should the vibration be at twice the shaft speed instead of at shaft speed, the four flashes per revolution would produce a double image. From the foregoing it will be seen that by working until a double image is produced, and knowing the ratio of the gear-box drive and the number of flashes per revolution that produces it, the periodicity of any vibration may be accurately ascertained without any calculation whatsoever.

As an example of a case in which it is necessary to drive the oscilloscope at a speed higher than that of the shaft, in order to find the vibration periodicity, suppose we consider a vibration occurring at eight times the shaft speed. Here it will be necessary to drive the oscilloscope at four times the shaft speed and employ four flashes per revolution before a double image will be produced.

Direction of a Vibration

In ascertaining the direction of a vibration, the double image phenomenon is again employed. The simplest mode of procedure is to make a light center-punch or similar mark on the vibrating part and to note the direction of the motion of this mark. Suppose, for instance, we are considering vibration on the top of an electric motor casing. If a mark is placed in the center of the casing top, we shall see two components of the vibration, namely, the axial and the transverse, and what we shall actually see by two flashes per revolution in the "creeping" position, will be two images of the mark following each other around in the form of an ellipse. The longest axis of the ellipse represents the predominant component, and the angular position of a line drawn through the longest axis, the resultant direction of the vibration.

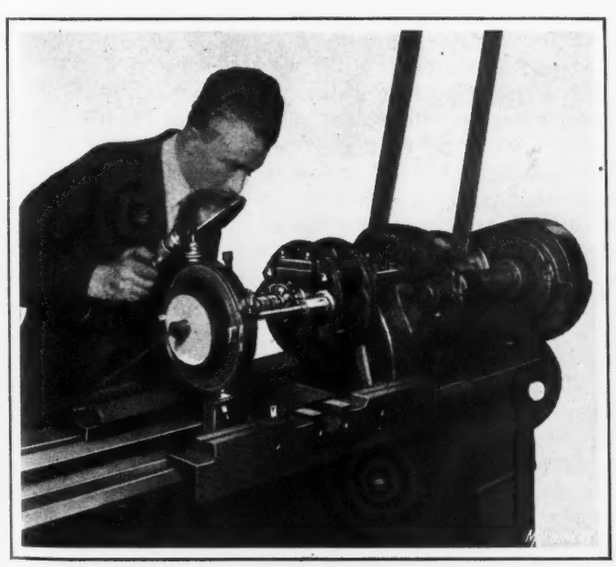


Fig. 2. Oscilloscope being used to observe the Action of a Formed Cutter Relieving Operation



Fig. 3. Rapidly Rotating Cutter as photographed under the Rays of an Oscilloscope Lamp; Time of Exposure, Three Minutes

Amplitude of a Vibration

The third function of the double image phenomenon is in the determination of the amplitude of a vibration. It has been pointed out that two flashes per revolution in the "creeping" position produce two images of the vibrating part, periodically approaching and receding from each other. Now suppose two flashes per revolution are employed in the "stationary" position; then a stationary double image of the vibrating part will be produced, and the distance between the two images will increase or decrease as the oscilloscope gear-box is slowly turned around on the shaft. If the distance between the two images is measured when it is maximum, this distance will denote the maximum amplitude of the vibration at the point at which the measurement is taken. It has been found that in most cases where the vibration is at shaft speed, the most accurate method of obtaining maximum amplitude is by turning the box around until the node, or the point at which the two images exactly coincide, is reached; then the box is turned through exactly 90 degrees, and the maximum reading is obtained.

Typical Vibration Problems

The diagram Fig. 4 shows a typical enclosed piece of mechanism (containing an unbalanced shaft), as it would appear under the rays of the lamp, if illuminated by two flashes per revolution in the "stationary" position, with the box turned around until the maximum displacement appears. For the sake of illustration, the vibration, as shown by this diagram, is of larger amplitude than would ordinarily be met with in proportion to the size of the case, but it is intended to show exactly what is meant by a "double image." It will be noted that the vibration shown here has a pronounced horizontal component x and a vertical component y, the horizontal being of greater amplitude.

The diagram to the right shows an enlarged view of a portion of the bearing boss. A center-punch mark has been placed on the vertical center line just above the shaft, and the double image of this mark is shown at the point of maximum horizontal amplitude, while the dotted lines show the

elliptical course taken by the two images of the mark as they follow each other around.

Above the center-punch marks are horizontal scribed lines, the distance between the images of which indicate the amplitude of the vertical component, and similarly if vertical lines were scribed, the amplitude of the horizontal component would be seen. Now suppose that two lines *A* and *B* have been scribed a known distance apart, say ¼ inch. Then if a double image appears exactly midway between the original positions of *A* and *B*, it shows that the amplitude of the vibration is exactly ⅛ inch, and similarly if the lines be scribed any known distance apart, the amplitude of the vibration may be arrived at.

The particular example here illustrated shows a vibration of large amplitude, but exactly the same thing may be done when amplitudes are very small, by employing suitable means for magnification, and successful measurements may be taken by the aid of a microscope with a micrometer attachment. If scribed lines appear too thick for accurate observations under the microscope, a glass disk having a hair line on it may be mounted on the vibrating part, and measurements of a high degree of accuracy may be taken in this manner.

Having considered the means of analyzing vibrations, we will now turn our attention to the manner in which these analyses may be employed. In the first place, it can be determined at once if a vibration bears any definite relation to the speed of a given shaft, or whether its frequency is determined by the natural free period of the vibrating part. If the latter case holds, then instead of seeing the vibration as an even swaying motion or completely arrested, according to the position in which the oscilloscope is being operated, the motion will seem to be following a varying rule, the pulsations appearing of varying amplitude and at varying frequency.

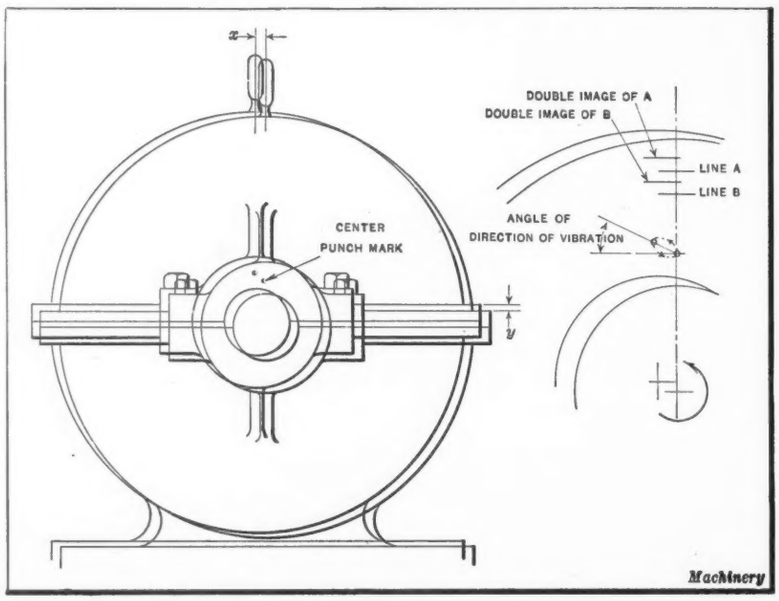


Fig. 4. Diagram illustrating "Double Image" Appearance of a Gear-case, which is subjected to Considerable Vibration; Enlarged View of Bearing Boss, showing Path followed by Punch Mark and Appearance of Lines for determining Vertical Amplitude

Occasionally one sees the shaft speed gradually approaching the natural frequency of the vibrating part, and this makes itself apparent by the fact that the pulsations will become more and more regular, until they finally reach complete synchronism. Again, what is occasionally seen is a free vibration superimposed upon one synchronous with the shaft speed, and this gives the appearance of a "ghost" or phantom playing around the edge of the main vibration.

From the phenomena described, it is possible to ascertain if a troublesome vibration on a certain component of a machine is entirely the fault of the shaft, or whether the component itself is not sufficiently rigid and readily takes up a free vibratory period. By being enabled to ascertain the periodicity of vibrations, means are provided whereby they may, in many cases, be accurately traced to their sources. Suppose, for instance, a machine has a number of shafts running at different speeds, and it has been impossible to discover the shaft that is responsible for a certain vibration. If the oscilloscope gear-box be coupled, in turn, to the different shafts, or to one of them, and through gearing given the speeds of any of the others, then the gear-box speed that will produce a true double image of the vibrating parts on two flashes per revolution will at once indicate the periodicity of the vibration, and consequently the shaft responsible for it.

Another case frequently met with in which the analysis of periodicity is of great practical value is in connection with crankshaft vibrations on reciprocating engines. Here it is found that the periodicity is at twice crankshaft speed, which indicates lack of secondary balance, owing to the fact that connecting-rods, not being of infinite length, do not transmit true harmonic motion to the pistons. A serious vibration of this nature will show at once that the weights of the reciprocating parts are not correct.

On certain machining operations where vibrations are causing chatter or ripple, to be able to determine the periodicity will often point to the cause. To take a simple example of an eight-tooth milling cutter, the vibration was found to be at eight times shaft speed; while this showed that the vibration was caused by a jar on every tooth, the appearance of the work indicated that it was the result of one high tooth. This was due to the fact that the effect of vibration occurred only when a soft spot was encountered in the stock. Suppose, however, that it was caused by one high tooth; then the analysis would show the vibration to be at shaft speed, and the high tooth could be readily located by noting the tooth that was in operation at the time when the displacement appeared to be at a maximum. A case in which a high tooth or teeth would appear to be causing trouble, but would defy all efforts to trace the tooth unless the machine were in motion, would be in high-speed operations where the shaft of the machine is out of balance; and here the oscilloscope provides a ready means of locating the cause.

Direction analysis gives much useful information, not only in arriving at the cause of vibration, but also in indicating the structural rigidity of the machine concerned. The fact that a vibration has a distinct axial tendency in its direction, where an observation is taken over the shaft of a machine showing signs of lack of balance, indicates the presence of a dynamic couple in the shaft, its extent influencing largely this tendency to axial direction; that is, assuming that the construction of the machine is not such as to allow excessive movement in the axial direction.

This brings us to the point of structural rigidity, which is very important, since it often has to be based on a compromise, where causes of vibration that cannot be overcome are present in the machine. In a case like this, it is usually desirable to cut down the vibration of the machine as a whole, as much as possible, but at the same time, if the construction is too rigid, fracture is likely to occur at weak points. It is therefore desirable to be able to check the directions at various points, in order that as evenly proportional a compromise as possible may be arrived at. It may be mentioned here that in some cases it is surprising how vibration directions alter when running through various critical speeds, and this alteration will

often show at once a lack of structural rigidity at a certain point.

Amplitude analysis is probably the most valuable function of the oscilloscope as applied to vibration problems, since the question foremost in the mind of the man dealing with them is: How much vibration is there? The opinions of people differ decidedly when it becomes a question of determining the amplitude of a high-speed vibration. An alteration made with a view to reducing the amplitude will often seem effective in the eyes of one man, whereas another will say that the trouble is worse than it was before the alteration was made. This particularly applies where vibrations are of very small amplitude, but if a thin line be scribed on the vibrating part, and the distance between the two images of this line, as observed under the rays of the oscilloscope lamp, is measured with a scaled microscope, both before and after the alteration is made, there is no point left for argument.

Means of accurate amplitude measurement permit of the investigation of critical speeds by observing the gradually increasing separation of the two images of a line until a maximum reading is attained, and noting the shaft speed at this point. The double image phenomenon may also be utilized in measuring the extent of movement in an oscillating motion of any amplitude, and occasionally will prove a useful method of determining the degree of overthrow in a motion of this kind. Although the latter may hardly be classed as a vibration analysis, it will have to be handled in exactly the same way.

Checking Balance of High-speed Rotors

Having described the means of carrying out analyses and the separate uses to which they may be put, we will now consider a case in which they are employed collectively, namely, in the balancing of high-speed rotors. This can be done with the rotor actually mounted in its permanent bearings, and with no preparation beyond providing means for driving the oscilloscope gear-box from one end of the shaft. The means employed is by analysis of the vibrations caused by the rotor around the bearings, and noting the position of the rotor with relation to the maximum displacement in a given direction. In carrying out this balancing operation, it will first be necessary to decide whether the vertical or the horizontal component of the vibration is to be considered.

In most cases it will be found that there is no choice between them in the matter of convenience, and therefore it is obvious that readings will be simpler to take and probably more accurate if the direction having the greatest amplitude is chosen. A mark is made on the bearing, from which the direction of greatest amplitude is ascertained; then a suitable line is scribed on the bearing, the line being vertical if the vibration be horizontal and vice versa. Let

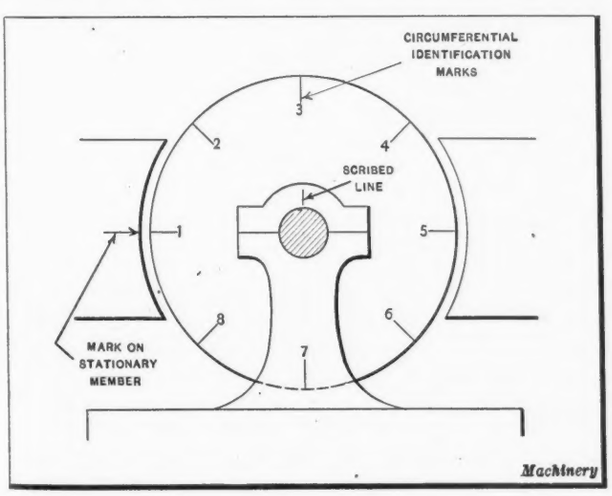


Fig. 5. Diagram showing Marks used in Connection with Rotor Balancing

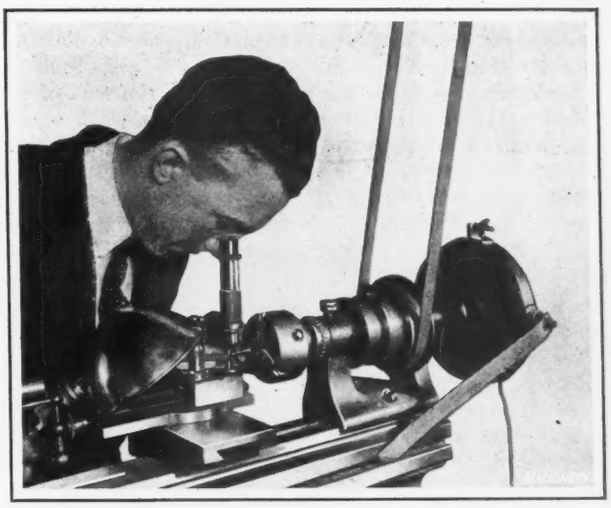


Fig. 6. If Necessary, a Microscope may be used in Conjunction with the Oscilloscope for examining Small Parts while in Motion

us suppose it has been decided to work from horizontal readings; then a vertical line having been scribed on the outer face of the bearing cap, a mark on the stationary part of the machine at a point along the horizontal center line is made, as shown in Fig. 5, which indicates diagrammatically a rotor set up in its bearings ready for balancing. Some means are then provided for identifying various points on the circumference of the rotor, such as a series of numbers chalked on different segments of the armature or spokes of a wheel, as shown in the illustration; if this is not convenient, the marks may be scribed on the shaft, but in this case, on account of the small diameter, the marks will have to be spaced with considerable accuracy.

Having made the necessary marks, the oscilloscope gear-box is attached to the shaft, and the rotor set in motion, the speed of rotation being increased, when it will be noted that the vibration will steadily increase in amplitude up to a maximum, until the "critical" speed is reached, when it will, on further speeding up, register a minimum reading while the shaft runs through its critical range, after which the vibration will once more increase. It should be remembered that for speeds below the critical range a deflection of the bearing in a certain direction will locate the heavy side of the rotor, while above the critical speed range, the deflection will denote the light side. The critical speed in most cases will be quite low, and therefore balancing will usually be carried out above it. As already described, the actual reading will be taken on the double image of the scribed line, but it is not always possible to tell from this which way the displacement has taken place, since we shall see two exactly similar lines. Now it will be necessary to reduce the number of flashes to one per revolution, in order to ascertain the position the rotor has reached, and if at the same time it is noted whether the right- or left-hand image of the line has disappeared, it is shown at once which way the deflection has occurred. For instance, referring to Fig. 5, assume that the speed is above the critical range, and that the box has been turned around until the maximum vibratory amplitude is reached, as shown on two flashes per revolution; then, if the switch is changed to give one flash per revolution and it is observed that the number 1 on the rotor has reached a point opposite the arrow mark on the stationary part of the machine, and at the same time the right-hand image of the line has disappeared, we know at once that the deflection has taken place to the left, and that consequently the light spot is in the vicinity of the number 1.

Another point that has to be considered is that the maximum vibratory amplitude does not correspond exactly to the heavy or light spot on the rotor, but there is a definite lag in the reaction of the bearings. When taking readings below the critical range, the bearing deflection will lag behind the heavy spot, but above the critical range it will

appear just in front of the light spot. The amount of this lag depends upon the speed of rotation, and its direction upon the direction of rotation, the amount being equal in either direction. Therefore, if the rotor be run first in one direction and then in the other, the mean position on the rotor between the two that correspond to maximum vibration will indicate the heavy or light spot, as the case may be.

Referring again to Fig. 5, suppose the point registering with the arrow is point 1 when vibration shows the maximum amplitude, and in the opposite direction of rotation, point 3 registers with the arrow; then the mean between these two points, namely point 2, indicates the heavy or light spot, as the case may be.

The broad principles underlying balancing operations with the oscilloscope have been dealt with in this article, but there are many variations from these principles that would require individual treatment. In all cases, however, the balancing can be carried out with the rotor mounted in position, and it is a comparatively simple operation, which permits of measurements being taken at intervals indicating exactly when the limit that represents a good commercial state of balance has been reached.

* * *

ASSEMBLING A GENEVA STOP-WHEEL MECHANISM

By W. OWEN

An important factor in the smooth working of a Geneva stop-wheel mechanism such as described on page 724 in May MACHINERY, which to the writer's mind is far more important than the locating of the driving roller on its arm is the accurate dividing or spacing of the slots in the driven plate and the positioning of these slots with respect to the cut-away portion of the plate. In the article referred to, it was assumed that a jig was not used to obtain the correct center distance between the two shafts. If there are many of the mechanisms to be made, the writer has found that a jig is indispensable.

The illustration that accompanies the article in May MACHINERY shows the mechanism designed to operate under ideal conditions; that is, the plate is revolved through an angle of 90 degrees by a corresponding movement of the arm, so that when the driving roller is entering or leaving the slot, the center line through the slot is at right angles to the center line of the driving arm. This, however, though advisable when possible, is by no means the condition always met with. The mechanism will work quite smoothly when the driving roller rotates through an angle of 70 degrees and imparts a 90-degree movement to the driven plate. An extremely accurate dividing head must be used in milling the slots in the driven plate of the mechanism. The same dividing head should also be used in conjunction with a circular table for milling out the curved portions of the plate. The writer knows of no smoother working mechanism for an intermittent non-reversing motion than the Geneva stop-wheel mechanism.

* * *

Water power is one of Canada's most basic and valuable natural resources. The capital invested in water power developments in that country is well over one-half billion dollars, making it one of Canada's greatest single industries. The known available water power in Canada is over 18,000,000 horsepower for conditions of minimum flow, and approximately 32,000,000 horsepower would be available for at least six months a year. These estimates are based on a 24-hour power basis. The total capacity of the water wheels and turbines so far installed in Canada is nearly 3,000,000 horsepower, or 338 horsepower per 1000 population. Canada's position is second only to that of Norway in the per capita utilization of water power. The present development represents an annual equivalent of nearly 27,000,000 tons of coal.

CASTING ALUMINUM MATCH PLATE PATTERNS

By JAMES F. HINES

The procedure followed in making double-faced metal match plate patterns was described on page 695 of May MACHINERY. Further information on the production and use of double-faced match plate patterns will be given in the following: The present article deals with the type of metal match plate pattern which is cast in aluminum, and which has an irregular parting line. This type of match plate can be rammed up and finished by hand on the bench or used in connection with the old style squeezer machine. It can also be used on a modern up-to-date power jolt squeezer, by jolting the drag and squeezing the cope and drag together at the same time. In this case, the cope is lifted off by hand, the plate being vibrated by either a pneumatic or an electric vibrator.

Until the last few years, it was generally believed that only certain types of patterns could be "plated" with good results. Today, by exercising proper care in making match plates, it is safe to say that over 90 per cent of the castings made in brass, iron, aluminum, malleable iron, and steel, weighing from one ounce to fifty pounds, can be successfully made from a match plate pattern. A properly made match plate will produce castings that are uniform in both weight and size.

Match Plates Reduce Production Costs

In some instances, the cost of production has been lowered three cents per mold through the use of match plates without reducing the molder's wages. Besides this saving, the number of pieces made in one mold has, in some cases, been increased 100 per cent, with very little increase in the size of the flask. For example, a manufacturer recently had a match plate pattern made for a coat and hat hook, which had been marketed by him for eighteen years. Brass gates with twelve pieces to a mold, in a 10- by 16-inch flask, had been used in producing the mold. At present, this manufacturer is producing twenty-four pieces in a flask, 12 by 16 inches in size, by employing a match plate.

In another case, a match plate was made up for producing a "pipe applier," an article which is sold at retail for ten cents. Naturally the margin of profit on this article is very small. In order to make the manufacture of the "pipe applier" profitable, a match plate pattern was made up; this enabled the operator to mold twenty pieces at a time, as against twelve pieces by the method previously employed. The labor cost also was reduced 2½ cents per mold. Such savings are made possible by carefully arranging the gating and the pieces in designing the match plate. Heavy or strong gating is not necessary when match plate patterns are used; in fact, the gating can be much lighter than that ordinarily used. Trouble is often experienced by the loosening of the pattern from the runner due to hard rapping and continual hard use. This trouble is avoided entirely when match plates are employed.

With the metal match plate type of pattern, the gates and runners are cast in one piece with the plate. As they are vibrated by air, which does not damage the plate, there is practically no expense for pattern upkeep. In constructing match plates, care should be taken to make them as nearly as possible 100 per cent efficient, as this costs but little more than to make them, say, only 50 per cent efficient. For example, a poorly arranged match plate may provide for the molding of ten pieces, whereas by a more careful arrangement it could be made to mold twenty pieces without any increase in size.

Production Requirements Determine Type of Pattern

The kind of match plate that should be used for any particular piece depends on the number of castings required. Match plates of the type here described are not the most

efficient form where large production is involved, but are best adapted for use in producing parts ordered in lots of, say, 1000 to 10,000 pieces. An order for a certain automobile part, now in the process of being filled by several manufacturers of malleable castings, required seventy different match plates in order to furnish the castings on schedule time. This order was much too large to be handled by a double-faced match plate type of pattern, as this would have required the services of too many men. Orders of such magnitude require a different molding method and a different type of pattern. No attempt will be made here, however, to explain the method or patterns used in this case, as they have been developed along entirely different lines from those described in this article.

An ordinary gate can sometimes be employed in the production of a match plate. This is more frequently done where the pieces are so small that the shrinkage does not affect the size of the pieces to any appreciable extent, or where a shrinkage of 1/16 or 1/8 inch in the size of the casting is allowable. The aluminum plate casting shrinks approximately 5/32 inch to the foot. When any shrinkage is objectionable, the gate pattern cannot, of course, be used in producing the match plate, and it becomes necessary to make a master pattern with sufficient allowance for the plate shrinkage and the final shrinkage of the parts. In order to produce match plates that are free from shifts and excessive or detrimental shrinkage at the points where the pattern joins the match plate, it is necessary to watch many details very closely.

Casting a Match Plate

At least two drag and two cope flasks made of metal and machined on each joint so as to be true and parallel should be available for producing aluminum match plates. These flasks should each have at least three hardened pins to insure accurate alignment. Hardened bushings should be fitted into the cope, and the mating pins in the drag should fit the bushings closely, so that there will be no shifting of the cope on the drag. The bushings and the pins should be so located that the four flasks (two drag and two cope flasks) will be interchangeable. For general purposes, a flask 28 by 38 inches is about the right size. The drag should be 6 inches deep, and the cope the same depth. Excellent results are obtained by using Red Lock sand mixed with 00 Albany sand in about the proportions of two-thirds Red Lock sand to one-third Albany sand. Nothing but the best No. 12 aluminum bought in ingot form should be used. A perfect master plate, so far as neatness and accuracy is concerned, can be obtained by this combination. All points of the master pattern should have a liberal draft; in fact, the draft should be about double the amount that the average patternmaker is accustomed to put on ordinary patterns. The molder who is to handle the work must have had a broad experience, possess a good eye, and have lots of patience. An assortment of odd-sized and odd-shaped slicks should be available for smoothing up partings, pockets and joints.

The master pattern is either set up on a sand match or blocked up properly on a machined plate. The size of the flask used depends on the nature of the plate. A cope flask is then put over the master, and the flask rammed up with a green sand match, after which it is clamped up and rolled over. The sand bed or metal plate is next lifted off, and a temporary parting made. Then a drag flask is placed on the cope, and sand riddled on the mold through a very fine riddle to a depth of about an inch. Following this, another inch or so of sand is added, using a 1/8-inch riddle, and finishing with a ½-inch riddle. The sand is then rammed hard and uniformly, after which the cope and drag are clamped together and rolled over.

The false cope is next lifted off and shaken out. Then the final parting is made, and finished up by powdering heavily and brushing with a fine camel's hair brush. It is then blown off clean, after which a light coat of parting material is added and the cope flask put in place. The cope is then rammed up the same as the drag. When this is completed, two men carefully lift the cope off, taking care to draw it off evenly, while a third man vibrates the mold by hand, using a stick placed under the mold for this purpose. This stick should be about 3 inches wide and 18 inches long with a cleat nailed to it. If a perfect lift is not obtained, the mold should be shaken out and the work repeated.

After a perfect mold has been obtained, the plate size is laid off on the drag mold. Strips of the exact thickness of the required plate are laid on the mold so that their outer sides coincide with the lines laid off on the drag mold. Then sand is filled in and struck off level with the strips. The strips that cover the drag up to the lines that determine the size of the plate are now removed. After this is done, gates are cut at each end of the plate. The pattern is next drawn out, and cores or chills are used to support the heavy sections. The cope and drag are well sprayed with molasses water, and each half of the mold is thoroughly dried. The mold is then closed, and the cope and drag clamped together and poured off as soon as possible. Two men should pour at a time, one at each end, and the pouring should be done with the metal as cold as possible. The cooler the metal, the smoother will be the castings and the less the shrinkage.

* * *

MACHINERY EXPORTS TO THE FAR EAST

In 1921, the United States exported $246,000,000 worth of industrial machinery of all classes, as compared with industrial machinery valued at $96,000,000 in 1913. Considering that prices were practically double in 1921, as compared with 1913, there was an increase of approximately 25 per cent in the actual volume of machines exported. Of the total exports in 1921, fully 26 per cent went to Asia, as compared with less than 7 per cent in 1913. During the last four years, the United States has sent $242,000,000 worth of machinery to Asia, which is equivalent in value to the exports of forty years at the pre-war rate, and in volume to the exports of twenty years. This indicates the great importance of the Far East as a market for industrial machinery. The Bureau of Foreign and Domestic Commerce has made a special investigation of this market, the results of which are covered in a report entitled "Asiatic Markets for Industrial Machinery," which has been compiled by W. H. Rastall, formerly a trade commissioner and now chief of the Industrial Machinery Division of this bureau. The report has recently been made available for distribution, and can be secured from the Superintendent of Documents, Washington, D. C. The price is 60 cents. The book contains 344 pages, liberally provided with maps, charts, tables, diagrams and illustrations. Those interested in the export of machinery will find in this report a careful study of the Asiatic markets and of the position of American products in these markets.

* * *

Although business in the tractor industry and farm machinery field is still far from normal, the improved conditions in these fields are indicated by the price advances that have taken place. The orders received from dealers during the early part of the year exceeded the estimates to such an extent that manufacturers have found themselves compelled to increase their production schedules and to come actively into the market for raw materials. The price advances in the tractor and agricultural machinery field are justified by the increases in the prices of raw materials and the shortage of dependable labor, which have added to production costs. Farmers are in great need of new machinery, and there has been practically no buying during the last two years.

Design of Harmonic Cams

By C. O. RHYS

WHEN the motions of a cam-operated automatic machine have been decided upon, the timing determined, and the time chart prepared, the next step is to work out the actual sizes, throws, etc., of the cams themselves. In a machine that has many cam-actuated motions, it frequently becomes a long and tedious process to lay out the cams so as to have them meet the required conditions. They must be kept within the available space, the angle of climb must be kept within the proper limits, under-cut must be avoided in machining the cam tracks, and the throws must be calculated for each cam while passing through the angle of turn provided for by the time chart.

The accompanying table of formulas has been found by the writer and by many designers and draftsmen of his acquaintance, to facilitate the work of laying out cams to a considerable extent. All the factors mentioned can be rapidly and accurately calculated before a line need be drawn, slide-rule results being more than sufficiently accurate. Probably one or two examples will show the use of the table better than the most elaborate explanation.

TABLE OF FORMULAS FOR LAYING OUT HARMONIC CAMS
(Angles are in Degrees; Distances in Inches)

Symbol	Description	Formula
a	Angle of action of cam	
b	Angle corresponding to maximum steepness of cam track	$\frac{ad}{180}$
c	Maximum angle of climb	$\text{Tan } c = \frac{90t}{a\sqrt{R\,(R+t)}}$
d	Angle turned through by r corresponding to maximum steepness of cam track	$\text{Cos } d = \frac{r}{R+r}$
a_1	Value of a when the distance of every successive point on the cam track from the camshaft constantly increases	$180\sqrt{\frac{r}{R}}$
r	Half-throw of cam, or radius of cam-curve generating circle	
t	Travel or throw of cam	
R	Radius of base circle of cam curve	$r\left[\sqrt{\left(\frac{180}{a \text{ tan } c}\right)^2+1}-1\right]$
C	Radius of curvature of cam curve at inner end	$\frac{(R+t)^2}{R+t+r\,(180 \div a)^2}$
C_1	Radius of curvature of cam curve at outer end	$\frac{R^2}{R-r\,(180 \div a)^2}$

Machinery

Suppose a cam is to be designed that will make a throw of 1½ inches while the camshaft is turning through an angle of 75 degrees. Suppose further that the angle of climb is not to exceed 30 degrees. Referring to the illustration Fig. 1, it is evident that if the radius R of the base circle can be calculated, and if the size of the cam-roll is known, the other dimensions of the cam may readily be determined.

From the table the formula for R is found to be

$$r\left[\sqrt{\left(\frac{180}{a \text{ tan } c}\right)^2+1}-1\right]$$

From the given conditions, r = one-half the cam throw, or ¾ inch; $a = 75$ degrees, and c = the angle of climb, or 30 degrees. Substituting these values in the formula, we have:

$$R = \frac{3}{4}\left[\sqrt{\left(\frac{180}{75 \times 0.5774}\right)^2+1}-1\right] = 2.45 \text{ inches}$$

If the cam-roll is taken to be 1 inch in diameter and the cam track is not to approach nearer than ⅜ inch to the periphery, then by adding together the known values, the diameter of the cam can be quickly determined. Thus:

2.45 = radius of base circle;
1.50 = throw of cam;
0.50 = radius of cam-roll;
0.375 = thickness of metal beyond cam track;
4.825 = radius of cam.

Then the cam diameter is 9.65 inches.

If the radius of the base circle were increased slightly to obtain even figures, the climb angle would be slightly less abrupt than the specified 30 degrees. If we wish to check up this climb angle by laying it out, we must first find the point in the cam track where the maximum steepness occurs. This corresponds to a point on the cam track at which the radius of the circle generating the harmonic curve has passed through a certain angular turn, the magnitude of which is given in the table as

$$\text{Cos } d = \frac{r}{R+r}$$

Substituting known numerical values in this formula,

$$\text{Cos } d = \frac{0.75}{2.45+0.75} \qquad d = 76.5 \text{ degrees, nearly}$$

This angle, as the table of formulas shows, corresponds to the angle b turned through by the cam

$$b = \frac{ad}{180} = \frac{75 \times 76.5}{180} = 31.8 \text{ degrees}$$

from the point where the throw begins.

We can now examine the cam curve to see whether it is free from under-cut. Under-cut will not occur provided the radius of curvature of the cam curve is more than the radius of the cam-roll. The points of least radius of curvature of the cam track are the two ends, so that if these be great enough, the rest of the cam curve will not give trouble. The radii of curvature at the ends can be found by applying the formulas for C and C_1, given in the table. Thus:

$$C = \frac{(2.45+1.5)^2}{2.45+1.5+0.75\,(180 \div 75)^2} = 1.89 \text{ inches}$$

$$C_1 = \frac{2.45^2}{2.45-0.75\,(180 \div 75)^2} = -3.21 \text{ inches}$$

Both these values are more than 0.5 inch, the radius of the cam-roll, so that the cam track will not be under-cut. The minus sign for value C_1 simply means that the center of curvature is outside of the cam track, which would naturally be true for one center when the track has the shape of a reverse curve.

In some cams, where the angle of action is large, every successive point on the cam track is farther removed from

the center of the shaft, as shown in Fig. 2. The least angle of action, which is necessary for this condition, can be found by the formula for a_1 given in the table. Applying this formula to the cam under consideration,

$$a_1 = 180\sqrt{\frac{0.75}{2.45}} = 100 \text{ degrees}$$

That is, if the angle of action had been equal to, or more than, 100 degrees (other dimensions being the same), the track would have been of the character shown in Fig. 2, with its curvature constantly going away from the shaft center. In cases of this kind, C_1 may be very large, and the question of possible under-cut then depends upon the value of C only.

Limitations in Available Space

Now suppose that questions of available space had prohibited the use of a cam as large as 9.65 inches in diameter and that the maximum outside diameter could not exceed 8.50 inches. This would mean that radius R would have to be reduced by half the difference between 9.65 and 8.50 inches, or 0.575 inch. Then the angle of climb of the cam would be given by the formula for c, R being 2.45 — 0.575, or 1.875 inches.

$$\text{Tan } c = \frac{90 \times 1.5}{75\sqrt{1.875 \times 3.375}}$$

and

$$c = 35 \text{ degrees } 30 \text{ minutes}$$

This is by no means a severe angle for ordinary work.

We must now find the least radius of curvature for this cam curve, which is

$$C = \frac{3.375^2}{3.375 + 0.75\ (180 \div 75)^2} = 1.48 \text{ inches}$$

This is still a good deal in excess of the 0.5 inch radius of the cam-roll, so that there will be no under-cut of the cam track.

Conditions Causing Under-cut

Under-cut is usually caused by the combination of a small angle of action, a high climb angle, and a large-diameter cam-roll. For instance, if we take an angle of action of 60 degrees, a climb angle of 45 degrees, and a cam-roll of 2 inches diameter (relatively large for a 1½-inch throw) we find that

$$R = 0.75\left[\sqrt{\left(\frac{180}{60 \tan 45}\right)^2 + 1} - 1\right] = 1.62 \text{ inches}$$

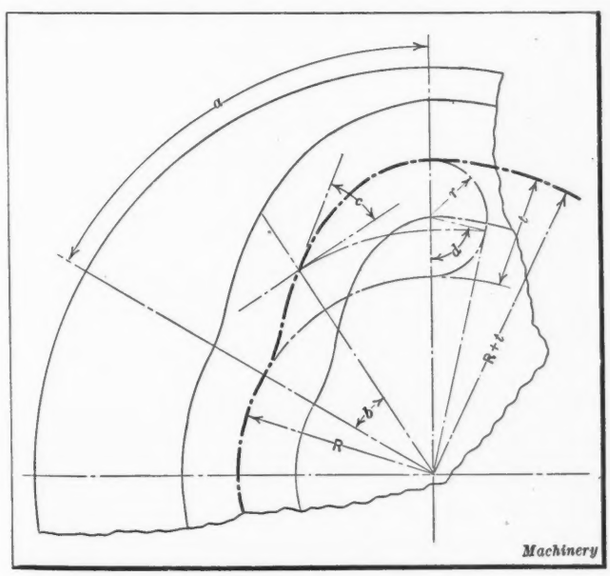


Fig. 1. Diagram for laying out Harmonic Cams

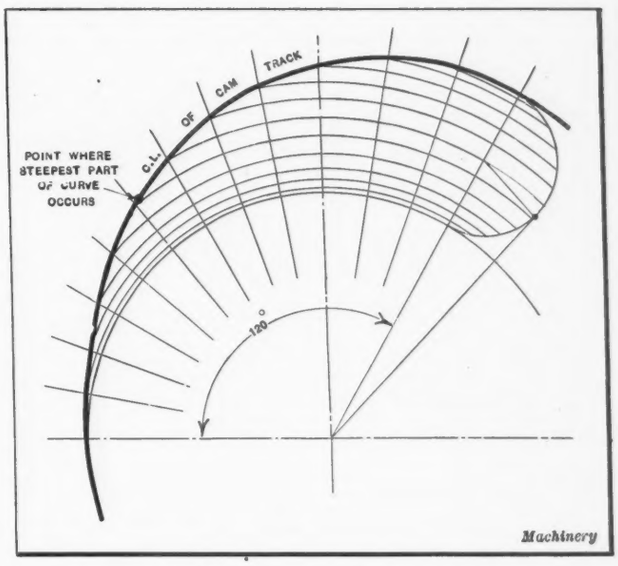


Fig. 2. Character of Curve when Angle of Action is Large

and

$$C = \frac{3.12^2}{3.12 + 0.75\ (180 \div 60)^2} = 0.985 \text{ inch}$$

The value of C then is less than the radius of the cam-roll, a condition that will, as previously stated, cause under-cut.

The foregoing examples, together with the table of formulas and their application, will probably be sufficient to show how the cam elements, for a given set of conditions, can be arrived at accurately without having to spend a considerable amount of time in laying out cam curves.

* * *

ARC WELDING IN THE FOUNDRY

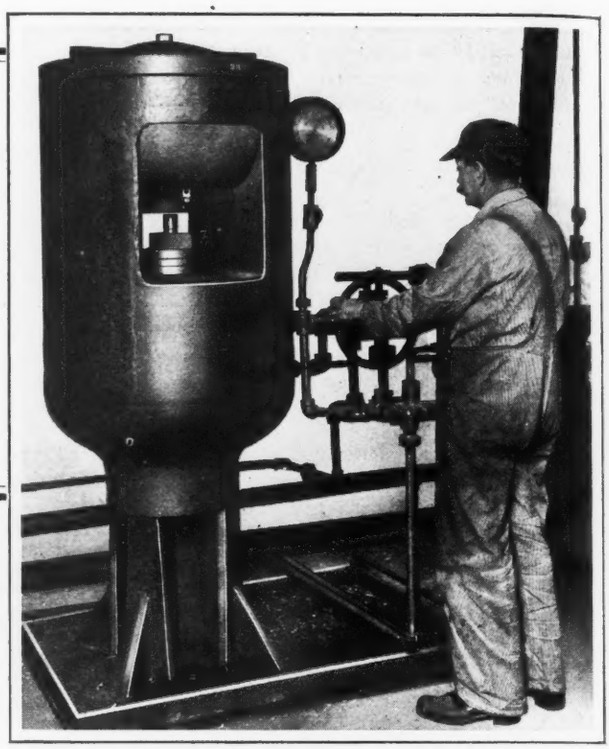
One of the most recent applications of arc welding in foundry practice is in the repairing of worn flasks, according to a statement made by A. M. Candy of the Westinghouse Electric & Mfg. Co. The operation is said to have been very successful and to result in marked savings. When the hole in the upper malleable iron lug of a flask wears to such a large diameter that the pin in the other half of the flask will not fit it sufficiently tight to hold the parts in alignment, the hole can be reamed out to a diameter of about ¼ inch larger than that required for the pin, and then completely filled by the use of the metallic electrode arc-welding process. A new hole is then drilled through the built-up metal. The object of having the filled hole ¼ inch in diameter larger than the size ultimately required is to prevent difficulty in drilling the hole. There will be a layer of very hard, chilled, high-carbon cast steel about 1/16 inch thick in the region where the deposited metal unites with the casting. This metal will not affect the drilling if the filled hole is made ¼ inch larger than the final drilled hole. The cost per hole, for welding, is stated to be from 6 to 7 cents.

* * *

An automatic furnace for hardening rock drills, working on the principle that steel becomes demagnetized at its critical temperature when it is ready to be quenched, has been developed in South Africa. It is stated that the tool, when it has reached the required temperature, disconnects an electrical circuit so that it is automatically pulled from the furnace, operating a bell as it is withdrawn and thereby giving notice to the hardener that the tool is ready for quenching. It is claimed that uniform results are obtained with this furnace, and that tools can be hardened at the rate of from 150 to 200 per hour.

Making Steel Molds by Hobbing

Process of Sinking Duplicate Impressions in Mold Dies by the Use of Hobs in Conjunction with Enormous Hydraulic Pressure



IN the manufacture of molded products, such as are made from bakelite, hard rubber, and various compositions for the electrical and numerous other industries, the making of the molds is a very important feature. As steel molds are the most durable and satisfactory, they are being used chiefly at the present time, although some molds are made of cast iron or soft metal, depending upon the material to be molded and the class of service for which they are to be used. This article is confined to the making of steel molds. Incidentally, a mold, as the term is here used, consists of an upper die and a lower die for forming a complete cavity into which the given product can be molded. It is evident, therefore, that the function of these upper and lower dies is similar to that of the cope and drag in ordinary foundry work, except that they are made of steel and are used for relatively small parts.

As these molded products often are required in large quantities, a multiple process of molding is commonly employed, whereby a number of duplicate parts are molded at the same time. In connection with this method, several molds are required, which has been an important factor in developing methods of producing duplicate molds cheaply and accurately.

General Methods of Making Molds and Principle of Hobbing Process

There are three general methods of producing the dies for forming molds: One is by machining; another is by a so-called "hobbing" process; and a third method is by combining the machining and hobbing processes. The machining method is unsatisfactory, particularly when the impression in the die is of complex or intricate form and must be duplicated in several molds, because duplication is practically impossible, and the work requires not only a high degree of skill but also considerable time. For this reason, the machining method, generally speaking, is impracticable, although it might be employed for making very simple dies, especially if it is not necessary to produce these in duplicate.

The hobbing process has long been employed for making dies such as are used in producing coins, medals, and various products of the silversmithing and jewelry trades. This method is designated as hobbing, because a "hob" or "force" is used, which is in the form of a punch and has a shape corresponding to the impression required in the die. In other words, the hob, at its formed end, is a duplicate in hardened tool steel, of the part to be molded in the hobbed die. While this hob must be made accurately and be given a fine finish, it is, of course, much easier to produce than would be a cavity or impression of corresponding shape. Furthermore, after the hob is made, it can be used to advantage in reproducing duplicate impressions in a number of different dies. The hob is hardened so that it will withstand the extremely high pressures employed in connection with the production of dies by this method.

In a general way, the method consists in forcing the hob into the unheated die blank by means of hydraulic power so that the shape of the hob is reproduced in the die impression. As this method is ordinarily employed, however, considerable difficulty is frequently experienced on account of the hardening of the die as the hob is forced into it. To overcome this, it is customary to force the hob part way in and then anneal the die. In some cases, the annealing must be repeated quite a number of times before it is possible to finish the impression. This repeated annealing requires considerable time, and is not conducive to the best results, because wherever the hobbing is discontinued for annealing, a slight wave or ridge is left in the impression.

Improved Method of Hobbing Mold Dies

An improved method of producing dies has been developed by the Burroughs Co., 246 N. Tenth St., Newark, N. J. The hob used in connection with this method is similar to the type ordinarily employed, but the pressure is exerted against the die being formed in such a way that die impressions requiring several annealings by the old method are finished in "one push," or by a continuous operation. Special hydraulic presses are used for this work, in order to secure a gradual application of the high pressures required. One of these presses is shown at work in the heading illustration. As will be seen, it has a rodless frame formed of one solid casting. The press is operated by a duplex type of pump having two plungers on the low-pressure side and two plungers on the high-pressure side. The low-pressure side is used in making ordinary adjustments, and the high-pressure side is employed for the hobbing operation.

If the die to be made is a simple form and the impression is easy to produce, the hob is forced into the die blank without confining the blank, which is allowed to spread laterally as the hob descends. The impression thus formed is slightly larger than the hob, but for many classes of work this difference in size is negligible. The die blank which has been bulged outward is machined afterward to whatever external width may be required.



Fig. 1. Typical Hobs, and Dies which have been formed by them under a Hydraulic Press

When an impression must be an accurate reproduction of the hob, the equipment includes a heavy "chase ring," having a hole in the center in which the die blank is confined while the hob is forming the impression. This central hole is in a hardened tool-steel bushing which fits into the main body of the chase ring. The latter is made of pack-hardened machine steel, and it is heavy enough to prevent any lateral spreading of the die blank as the pressure is applied. On one side of the die to be formed there is the hob, and on the other side a hardened plug of cylindrical form; the die blank is between these parts and within the central hole of the chase ring. As the pressure is gradually applied, the metal of the die blank flows slowly over the hob end, so that the shape of the latter is accurately reproduced in the die impression.

The Hob and its Relation to the Die Blank

It is evident from the foregoing that the making of these dies or mold sections requires (1) a hob or force shaped to fit the required impression; (2) a die blank of suitable size and shape; and (3) hydraulic press equipment capable of exerting the extremely high pressure required for forming the impression in the die.

The hob itself is made from high-carbon tool steel, and accuracy of form combined with a very smooth finish are essential. (See Figs. 1 and 2.) In many cases the hob also requires engraving either to form lettering or possibly an ornamental design. The hob must be without under-cuts, and a certain amount of draft or taper is essential, about 1 degree being considered the minimum. After the hob is machined and polished, it is made glass-hard, iced brine sometimes being used to obtain the greatest degree of hardness. The importance of a fine finish is illustrated by the fact that slight scratches would be reproduced in the die impression, and even a piece of lint between the hob and die would leave an imprint. After hardening, the general practice is to draw the temper very slightly by immersing the hob in boiling water.

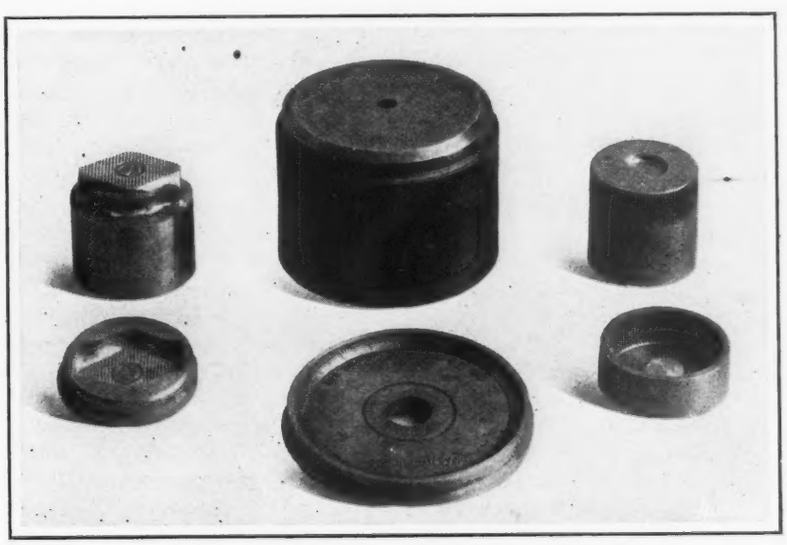


Fig. 2. Additional Examples of Hobs and Corresponding Dies

The difficulties encountered in hobbing die impressions depend in a general way upon the relation between the form and the depth of the impression. For instance, a die having a comparatively shallow impression of simple shape, can be made readily and may not require much experience, but if the impression is deep in proportion to its size, and particularly if there are fine edges or designs which must be an accurate reproduction of the hob, there are a number of important points to consider, as outlined in the following: Aside from the exacting and skillful work of making the hob, much depends upon the shape of the die blank, assuming that the impression is not a simple one to reproduce. Sometimes a plain cylindrical die blank having flat ends may be used, whereas other blanks are given a slightly conical shape on the impression side in order to supply metal where it will be needed as the hob is forced into the blank. Still other blanks are machined to form the impression partially, and in some cases the machining is done on the side opposite the impression to allow the metal to flow to the best advantage. Each die represents a separate problem, because the exact method of producing it depends upon the shape of the impression and its depth, and the best form of blank to be used in a given case often must be determined experimentally.

General Procedure in Hobbing a Die

After the hob has been made and is hardened, and the shape of the blank has been determined, the actual making of one or more dies is a short operation. If the die is of a

type requiring the use of a chase ring, this ring, together with the hob and die blank, is placed between the ram and the press anvil; a hardened steel plunger is also placed on the side of the die blank opposite the hob. The die blanks are made either of low carbon steel or of high-grade wrought iron, it being essential to use metal having good flowing qualities. The steel is annealed thoroughly before it is used to remove any hard spots and reduce the pressure required for hobbing. Although well annealed tool steel can be hobbed, its flowing quality is relatively poor, so that the hobbing of deep impressions is particularly difficult.

The press is controlled by two handwheels (see the heading illustration) which operate valves, thus regulating the flow of liquid from the pump, and consequently the action of the press ram. As soon as the ram encounters the high resistance due to the hobbing operation, the suction valves of the low-pressure pump are lifted automatically from their seats and the high-pressure side comes into action. The ram then ascends very slowly, although a die impression may be finished within one or two minutes, the time depending, of course, upon the depth of the impression. As the hob sinks into the die blank, the operator watches the pressure gage. The pressure ordinarily rises to the maximum required for a particular die, and then remains nearly stationary as the hob continues to sink into the impression. This continuation of the hobbing operation at practically the same pressure indicates that the work is proceeding satisfactorily and that the metal is flowing up around the hob. As soon as the latter reaches the required depth, the pressure immediately rises, which shows that the operation is completed.

The pressures required ordinarily range from 50 to 200 tons per square inch of die impression. The pressure not only varies for steels of different composition, but also depends upon the method of hobbing. For instance, if the die blank is confined by a chase ring, the pressure may be double that required for hobbing an unconfined blank. In some plants where only small dies or molds are used, a press of 150 tons' capacity meets the requirements, whereas in others, a press capable of exerting a pressure of 1000 or possibly 5000 tons may be necessary.

After a die has been hobbed in the manner described, the impression has a fine finish and clean-cut edges, because the smoothness of the hob is imparted to the die and the density of the metal is increased as the result of the enormous pressure. After the hobbing operation, the upper surface of the die, which is irregular owing to the unequal flow of metal, is machined to whatever shape may be required for matching the opposite die section. The die is then pack-hardened to a depth of about 1/32 inch ordinarily, and the temper may also be drawn, although this depends upon the class of service for which the dies are intended. The final operation is that of polishing the surfaces of the impression, to restore whatever luster may have been lost as the result of heat-treatment.

Examples of Hobs and Dies

In Figs. 1 and 2 a number of typical hobs are illustrated, and beneath these hobs are shown the corresponding dies. The two dies at the left of Fig. 1 are for molding knurled knobs. If these dies were made by machining, the usual procedure would be to make a knurled ring and a separate baseplate, thus forming a two-piece die. It is essential in this case to have a slight chamfer on the outer edge of the knob, and the difficulty of providing for this if the die were machined, is apparent. In fact, it would be impracticable, and the usual method would be to form the chamfer on the molded product by a separate machining operation. It will be noted, however, that this chamfer may be formed readily by the hobbing process, as it is only necessary to chamfer the end of the hob the amount desired. Another disadvantage of the two-piece mold is that a slight fin is likely to form at the joint between the two sections, especially after the die has been used, and this fin interferes with the ejection of the molded part and causes breakage at the corners.

The die shown in the central position, Fig. 1, also illustrates an advantage of hobbing. In this case, the bottom surface of the impression has a circular form, but each end of the slot terminates in vertical sides, consequently, it would be difficult to machine this impression. When the hob is used, it is simply cut away on each side, as shown, in order to form these vertical surfaces.

The next example in Fig. 1 illustrates a hob and die of fluted shape having lettering which is required on the molded product. The die at the extreme right has three equally spaced projections extending a short distance up from the bottom. Because of these projections, if this die were machined, it would be necessary to bore down as far as these small lugs, and then leave enough metal to form the lugs by milling in conjunction with hand work. When a hob is used, three notches are cut at the end of the hob, and projections of corresponding shape are formed in the die accurately and in the same relative position in different dies.

Referring now to Fig. 2, the die at the left has a letter in the center and a knurled bottom surface. The clean-cut and smoothly finished impression obtained from the hob is apparent from the illustration. The larger die shown in the center is for making a graduated dial of the type used for radio apparatus. In making the hob, the letters and figures are sunk into the end by an ordinary engraving machine, and the beveled edge is graduated by sinking lines or impressions of the right size and location. The die obtained from this simple form of hob, has, of course, raised lines, figures and letters, and the difficulty involved in making such a die by machining the surfaces to form these raised lines, figures, and letters is apparent to anyone at all familiar with machining processes. The die at the extreme right of this illustration is another example of the type used for molding knurled knobs. These few examples, which are typical, illustrate not only some of the advantages of hobbing, but also to some extent the variety of dies formed by this process, which, as may readily be seen, is capable of wide application.

The hob cost per die varies according to the number of duplicate dies to be made and the intricacy of the design. Frequently one hob can be used for making all the dies of one design that are required, and when the number is quite large, the hob cost per die is relatively low, especially as compared with machining, and the quality of the work is superior both as regards finish and accuracy.

* * *

FURNACE THAT SHOWS WHEN CORRECT HARDENING HEAT HAS BEEN REACHED

An electric furnace, known as the Wild-Barfield furnace, marketed by the Automatic Electric Furnaces, Ltd., 175 Farringdon Road, London, England, has been developed for the purpose of definitely indicating when the steel heated in the furnace has reached the temperature at which it loses its magnetic properties, so that quenching and consequent hardening may take effect at the right moment.

A coil of wire is wound around a form that constitutes the walls of the furnace. This wire is heated by its resistance to the passage of an electric current. Around the heating wire coil is placed another coil which is connected to some form of galvanometer. The passage of the current through the heating coil induces a current in the external coil which is modified by the magnetic action of the iron or steel in the furnace. When the steel in the furnace has entirely lost its magnetism, the deflection of the galvanometer ceases, and this indicates that the temperature has been reached at which the steel should be removed and quenched.

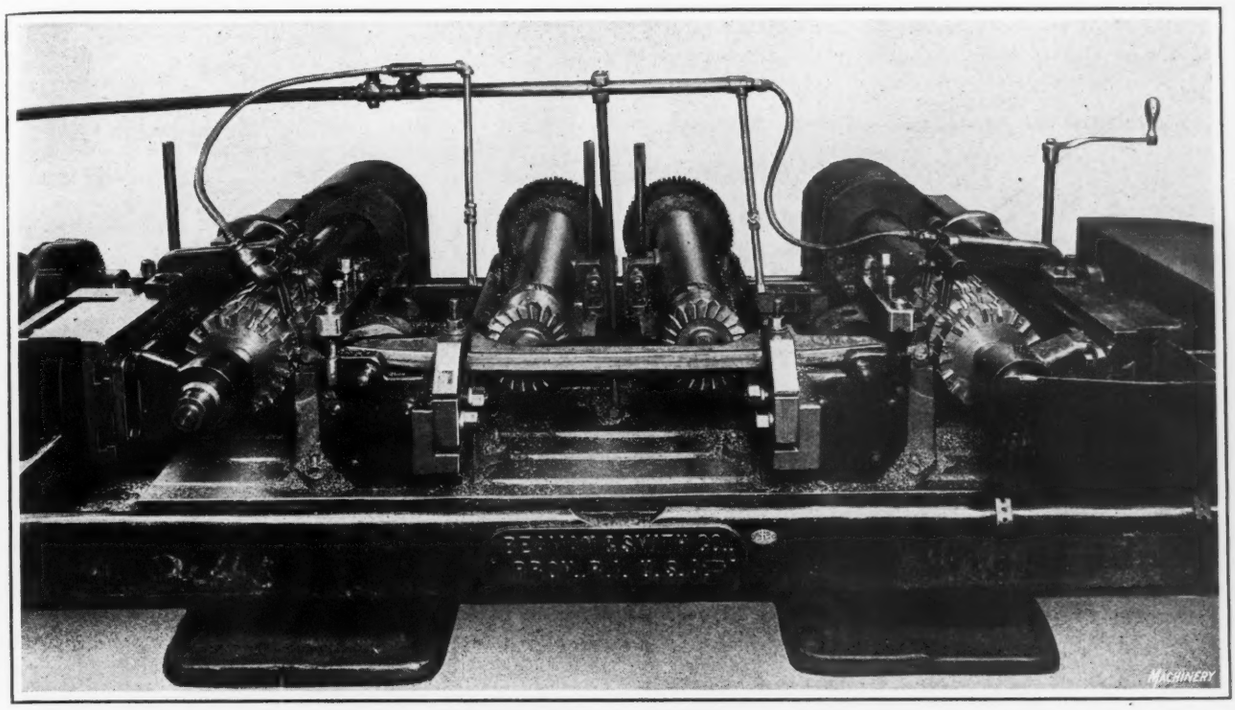


Fig. 1. Straddle-milling the Yokes and face-milling the Spring Pads of Automobile Axles

Manufacture of Automobile Front Axles

Machining Operations on Axle Forgings, Steering Knuckles, and Steering Arms

By EDWARD K. HAMMOND

THIS article describes the manufacturing procedure followed in making front axles for both passenger automobiles and motor trucks, and gives similar information relating to the machining of steering knuckles and arms, which may properly be regarded as part of the front axle equipment. The practice described is that of the Eaton Axle Plant of the Eaton Axle & Spring Co., Cleveland, Ohio. The forgings are made of molybdenum steel, and are double heat-treated, in accordance with S. A.E. specifications.

All forgings receive a searching visual inspection and are ground to reveal any structural defects or cracks at those points where the service is expected to be exceptionally severe. This grinding operation, of course, simply removes the outer scale. The front axle forging, for example, is ground on the surfaces along the yokes at each end, which immediately brings to notice any defects that may be present in the steel or have been caused by the forging.

The first step in machining the front axle forgings consists of straddle-milling the surfaces *A*, Fig. 3, at the yoke ends of the axles, and milling the spring pad surfaces *B*. The forgings are set up on a Beaman & Smith special milling machine in the manner illustrated in Fig. 1. Eight inserted-tooth milling cutters are used for the straddle-milling operation, and two solid side-milling cutters are used for the spring pad surfaces. The axles are laid flat in the milling fixture, which has provision for adjusting the position of the work relative to the cutter. The fixture is equipped with substantial hinged clamps to give rigid support in back of the spring pads and other clamps at each end near the yokes. By the arrangement shown, the axles are positively held against the thrust of the milling cutters.

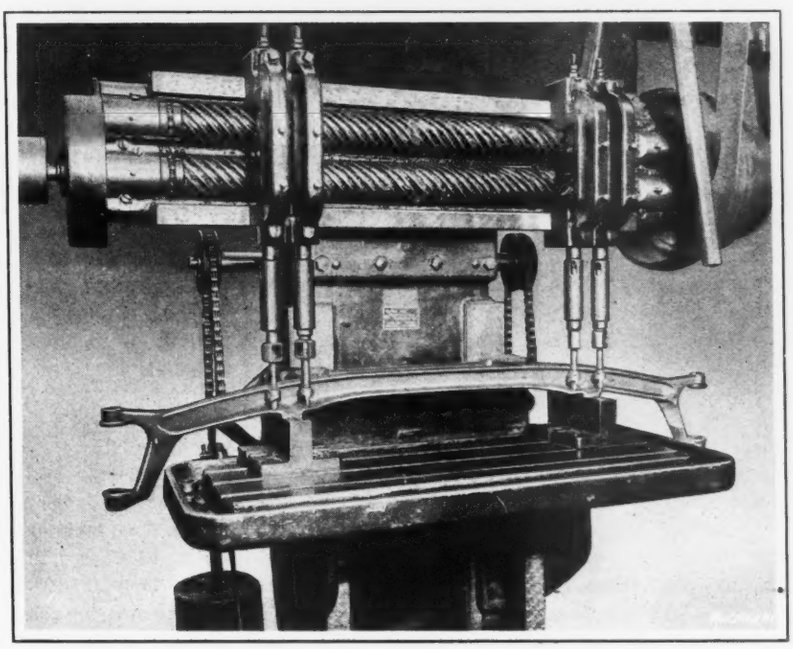


Fig. 2. Spot-facing the Under Side of the Spring Bolt-holes

The axle forgings are next drilled. This work is performed on a special Foote-Burt drilling machine having four spindles, two of which carry five-spindle auxiliary heads for drilling the holes *C*, Fig. 3, in the spring pads; the other two spindles are used for drilling the king-pin holes *D*, one at each end of the forging. All the drills operate together. The machine is equipped with an air-operated work-holding fixture consisting of a pair

of sliding V-blocks which engage the ends of the forgings. This arrangement enables the axles to be rapidly put in place and securely held during the drilling operations.

Reaming and Counterboring Operations on the Axles

The remaining machine work required to complete the axles consists of reaming the king-pin holes and counterboring the spring-pad holes from the under side. The reaming of the king-pin holes is done in a lathe, with the axle supported at the yoke end by a chain hook and a hoist. With this arrangement it is a comparatively easy matter for the operator to swing the work so as to advance it to the reamer. After reaming in the lathe, the holes are finish-reamed with a line reamer by hand.

The machine used for counterboring the spring-pad holes is a Moline "Hole Hog." The axle is supported on the table of this machine by T-irons in the manner illustrated in Fig. 2. Two piloted counterbores operate simultaneously on the holes at one side of each pad. The shanks of these counterbores are of reduced diameter so as to clear the I-section of the axle. The operation is simply one of spot-facing the surfaces for bolt-heads, and after the holes on one side of the web have been machined the position of the axle is changed for spot-facing the holes on the opposite side.

First Operations on Steering Knuckles

After the heat-treatment and preliminary inspection of the steering knuckle forgings, the work is delivered to a single-spindle Foote-Burt drilling machine where the king-pin hole *F*, Fig. 4, is drilled and reamed.

The forgings are next centered relative to the shank *H*, with the set-up illustrated in Fig. 7. The machine used is a duplex centering machine of Cadillac design. The steering knuckle is held in a fixture that contains a pilot at the rear for locating the work from the previously drilled king-pin hole. The shank of the forging is firmly clamped between two V-shaped jaws that are moved toward each other by a screw with opposite-hand threads, which is operated by the handwheel at the front of the machine. The spindles carrying the centering tools are advanced by hand by means of the two levers shown.

The turning of the shank of these forgings is done in a "Lo-swing" lathe, specially tooled. The tooling arrangement provides for turning the three straight diameters on the shank *H*, Fig. 4, as well as the tapered surface. A rear view of this lathe with its equipment, showing a forging mounted between centers, is shown in Fig. 5. The special turning attachment with which the lathe is equipped for this work enables all the surfaces of the shank to be turned during one traverse of the carriage.

The next operation in the sequence consists of rough-spot-facing both ends of the hole *F*, Fig. 4. This work is performed on a single-spindle Foote-Burt drilling machine, and the forging is located by a pilot fitting into the drilled king-pin hole. The spot-facing tools used in this operation are of the piloted type.

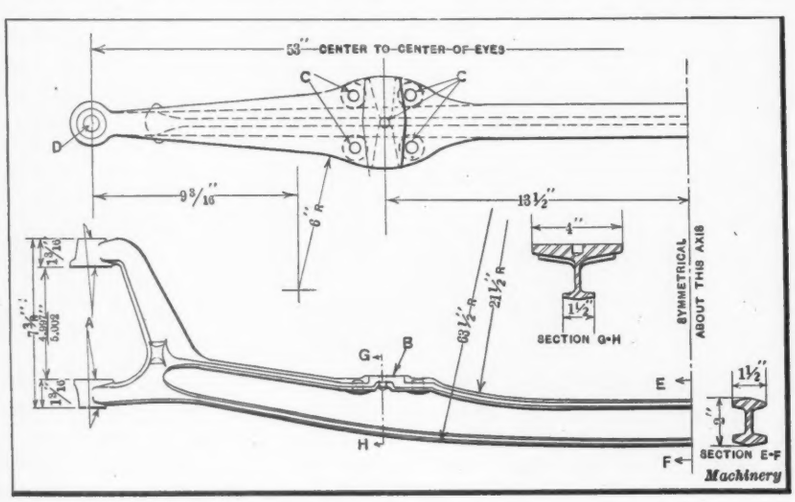


Fig. 3. Front and Plan Views of One End of an Automobile Axle

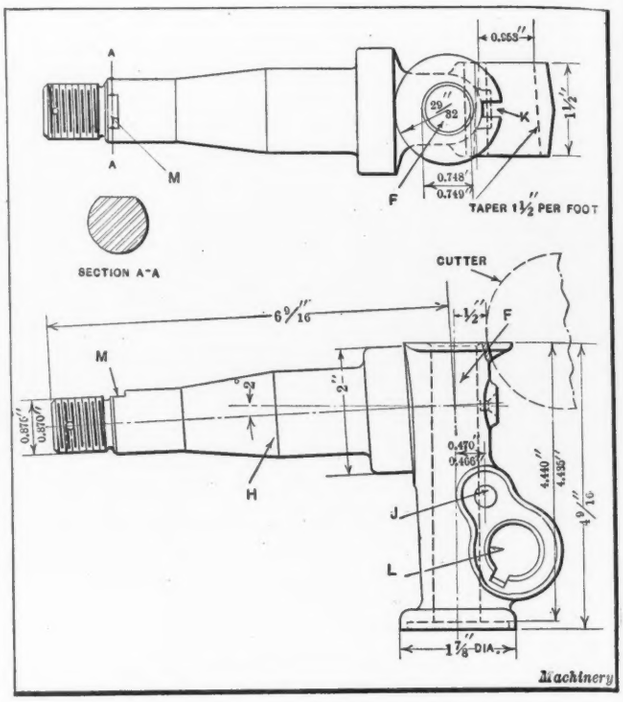


Fig. 4. Detail Views of an Automobile Steering Knuckle

The Foote-Burt single-spindle drilling machine on which the steering-arm hole *L*, Fig. 4, is drilled, is illustrated in Fig. 6. The fixture in which these forgings are located during the drilling operation contains pilots which enter the king-pin hole, and V-blocks which engage the shank. To compensate for variations in the form of the forgings, these V-blocks are operated by equalizing levers, as are also the pilots, which permits the work to be located, regardless of its irregularities, so that the steering-arm hole will be at right angles to the center line of the king-pin hole.

After drilling the steering-arm hole, the same type of fixture and the same type of machine are used in drilling and reaming the draw-key hole *J*, Fig. 4. Both the holes *L* and *J* are then spot-faced. During these operations the work is located by pilots which enter the king-pin hole, and is secured by straps which clamp the forging and hold it securely in a V-block. The tapered steering-arm hole *L* is then reamed on a Foote-Burt drilling machine. Two operations—roughing and finishing—are performed, in both of which special Skelton reamers are used. The roughing operation is shown in Fig. 8, where it will be seen that the special reamer used has straight cutting edges, whereas the type of tool used in the finish-reaming operation (see Fig. 9) has helical blades which take a very fine shaving cut and insure a good finish. In this jig also a pilot is employed to locate the forging correctly relative to the tools.

Milling, Spot-facing, Thread-milling, and Grinding

After the steering-arm hole has been finished, the forgings are transferred to a No. 3 Cincinnati milling machine equipped with a 2½-inch cutter for milling the slot *K*, Fig. 4. This slot is for the accommodation of a lock-pin. A keyway is then broached in the steering-arm hole *L*, using a Lapointe broaching machine and standard broaching equipment.

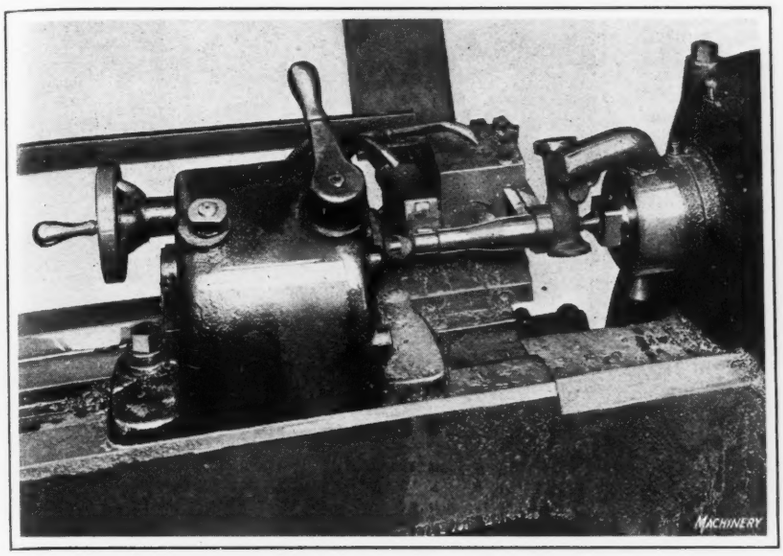


Fig. 5. Turning the Shank of the Steering Knuckles in a Lathe having Special Tooling Equipment

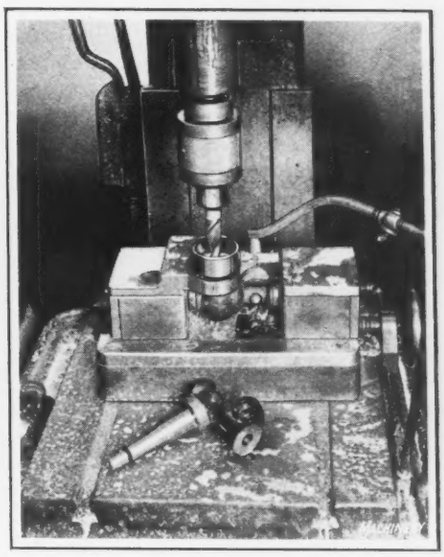


Fig. 6. Set-up for drilling the Arm Hole in the Knuckles

From Fig. 4 it will be seen that the distance from the counterbored surface surrounding the king-pin hole to the opposite end of this hole has a tolerance of 0.005 inch. To establish this dimension, a finishing operation on the previously counterbored hole and on the surface surrounding the hole at the opposite end is performed. The work consists of finish-spot-facing and finish-counterboring, and is done on a Warner & Swasey hand screw machine. After this operation has been completed, a flat *M* is milled on the shank near the end which is later to be threaded. This slabbing is done on a No. 2 Cincinnati milling machine with the work piloted in the king-pin hole and the shaft *H* secured in V-blocks. The purpose of the flat is to afford the necessary bearing surface for a lock washer. Two cotter-pin holes are next drilled in the end of the work.

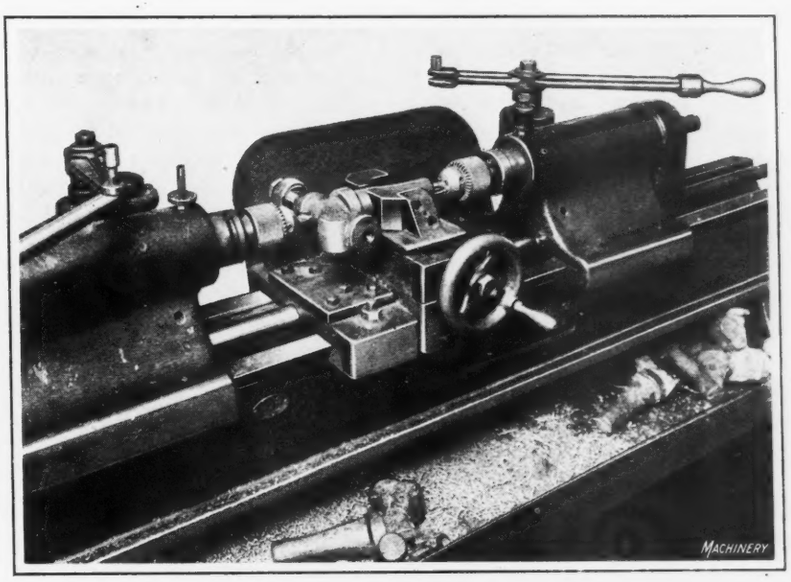


Fig. 7. Centering the Steering Knuckles

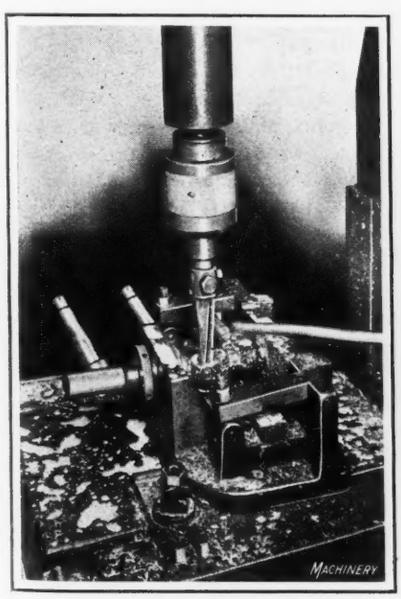


Fig. 8. Rough-reaming the Arm Hole in the Knuckles

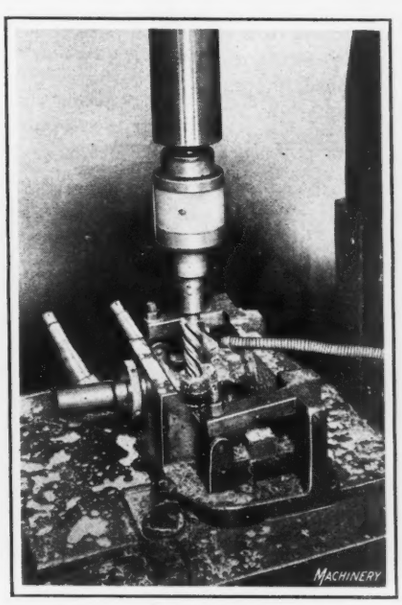


Fig. 9. Finish-reaming the Arm Hole in the Knuckles

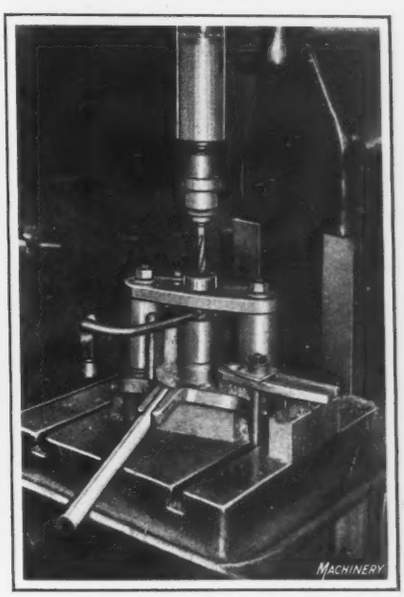


Fig. 10. Set-up for drilling the Steering Arm

The forgings are now ready to have the threads cut in the ends. This is done on a Lees-Bradner thread milling machine. The threaded end is next faced off in a Reed speed lathe and the work is recentered, preparatory to grinding the shank. During the recentering operation the work is located in a steadyrest which holds the shank by the large diameter. The final operation is that of grinding the two straight diameters of the shank, and for this purpose a Norton cylindrical grinding machine and wheel are employed.

Machining Automobile Steering Arms

The steering arm that is assembled to the steering-wheel end of the axle is of the design shown in Fig. 11, and has an extension *T* to which the drag-link forging is attached. The drag link connects the steering arm with the steering-wheel shaft by means of a bolt passing through hole *P*. The opposite-hand arm has no such extension; it inclines at an opposite angle, but otherwise is of the same appearance as that shown in Fig. 11.

After the preliminary heat-treating and grinding to disclose structural defects of the forging, the first machining operation is performed with the drilling machine set-up shown in Fig. 10. The forgings are held in a "pump handle" type of jig attached to the table of a Foote-Burt vertical-spindle drilling machine while drilling holes *O*, Fig. 11, and also hole *P* (in the case of the drag-link type of steering arm). The pump-handle jig is a convenient means of clamping the work for operations of this kind, it being merely necessary to push down on the long handle shown projecting from the front of the jig to raise a spring-actuated clamping member and release the work. In reloading, a forging is slipped into place while the handle is down, after which the spring clamp is forced down on the work by raising the handle. Various methods of locating are used on jigs of this type, but on such pieces as steering-arm forgings it is convenient to use bell-mouthed bushings that embrace the boss in which the hole is to be drilled.

The spot-facing operation for holes *O* and *P* is performed by a battery of two-spindle Barnes drilling machines. One of these machines is illustrated in Fig. 12 with two fixtures on the table of the machine, one of which shows the work in place and the other unloaded. These holes, it will be noted, are tapered so that in locating by means of a pilot, it is necessary to use a different pilot arrangement for each side of the boss. This is a very simple matter where the job consists of spot-facing that surface of the boss which is at the small end of the hole (in which case the work is simply slipped over the tapered pilot), but when the opposite side is being machined and the forging is reversed in position, a special arrangement is necessary. To locate the work in this position, the tapered pilot is dropped into the hole, this pilot or pin having a shank which enters a hole

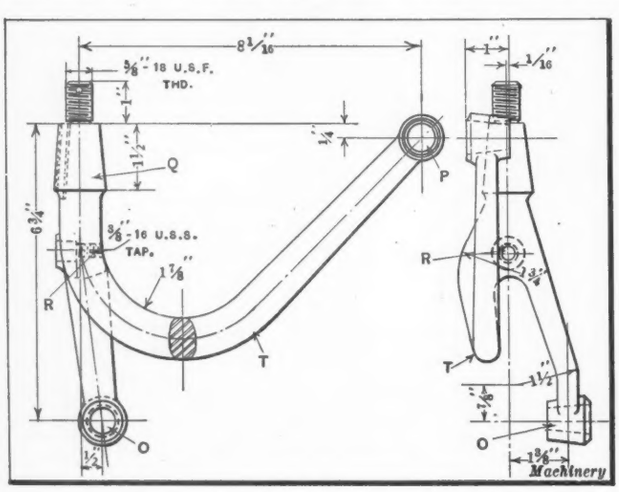


Fig. 11. Steering Arm of the Type used on the Steering-wheel Side of Automobiles

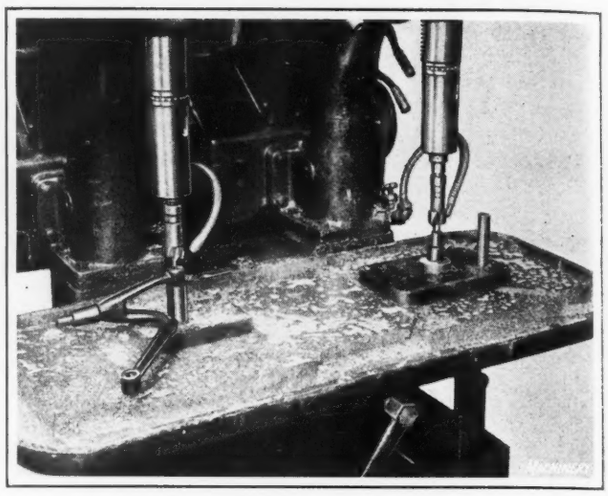


Fig. 12. Two-spindle Machine and Fixtures for spot-facing Holes in Steering Arms

in the work-holding fixture. In both cases the pilot which enters the hole is of such a length that it leaves exactly the necessary space between it and the end of the facing tool pilot to establish the correct depth of cut.

The drilling and spot-facing operations on the holes *O* and *P*, Fig. 11, having been finished, the forgings are set up on a Warner & Swasey turret lathe which is equipped with a pot chuck for holding the steering arm while the surface *Q* is being taper-turned and the end threaded. For cutting the 5/8–18 U. S. F. thread on the work, a Geometric die-head is used on the turret lathe. The final machining operations are drilling and tapping hole *R* for a 3/8–16 thread stop-screw. The work is located over a pilot which enters the tapered hole *O*. These drilling and tapping operations are performed on Cincinnati-Bickford vertical drilling machines. This completes the machining of the steering arms, and they are then delivered to the assembling department, where they are assembled with the steering knuckles into the front axle yokes.

* * *

RESULTS OF EFFORTS TO PREVENT ACCIDENTS

The United States Steel Corporation has carried on a consistent campaign for reducing accidents in its mills and shop since May, 1906. The results of this safety campaign are best indicated by pointing out the reduction in the number of accidents per 1000 employes. Since 1920, the accidents, compared on this basis, have been less than half what they were in 1906, and if the men were subjected to the same rate of accidents today as they were in 1906, 3000 more men would have suffered serious or fatal injury in 1922 than is now the case. As a matter of fact, in the seventeen years that have passed since the inauguration of the safety work in the mills of the United States Steel Corporation, over 35,000 men have been saved from serious or fatal injury, basing the number of injuries upon the average number previous to the inauguration of the "Safety First" campaign. The value of these figures is that they show what can be done in a practical way in accident prevention. Safety work, while it should be undertaken from humanitarian motives, is generally recognized to be a business proposition as well, and to have great economic value not only to the employer, but also to the employes and the entire community.

* * *

The Pressure Vessel Committee of the American Bureau of Welding has issued a report relating to welded pressure vessels, which is published completely in the May number of the Journal of the American Welding Society, and which may be obtained from the society's headquarters, 33 W. 39th St., New York, at $1.50 by members and $5 by non-members.

American Standard Screw Threads

THE report of the sectional committee on the standardization and unification of screw threads, upon which work has been in progress for some time, has now been placed for final adoption before the councils of the American Society of Mechanical Engineers and the Society of Automotive Engineers. Upon approval and adoption by these boards, it will be submitted by them to the American Engineering Standards Committee for formal adoption as the American standard for screw threads.

The sectional committee referred to was organized in the fall of 1920, with instructions to make a complete review of the progress report of the National Screw Thread Commission. In April, 1921, the members of the committee began their detailed study of the screw thread commission's report, and the work has since proceeded under the chairmanship of Luther D. Burlingame of the Brown & Sharpe Mfg. Co., Ralph E. Flanders of the Jones & Lamson Machine Co., being vice-chairman, and Clifford B. LePage, of the American Society of Mechanical Engineers, secretary. In carrying out its work, the sectional committee found slight modifications in the report of the National Screw Thread Commission desirable, and these changes were thoroughly discussed with the commission; the meetings with the commission led to the adoption of modifications that were mutually satisfactory.

Field Covered by the Report

The sectional committee has definitely limited the field to be covered by its first report to screw threads for bolts, machine screws, nuts, and commercially tapped holes. The report as now presented contains: (1) Definitions of the terms used in screw thread practice; (2) symbols to be used for screw thread parts; (3) specifications for the form of thread; (4) number of threads corresponding to given diameters; (5) classification of fits; (6) tolerances; and (7) appendices relating to derivation of tolerances, and the relation of lead and angle errors to pitch diameter tolerances.

This report does not present a new set of standards for screw threads, but rather an extension of existing standards, by specifying limiting dimensions for the various sizes and pitches of threads already in common use. It also gives official sanction to certain processes, such as over-size drill sizes, which have long been established by common use. Altogether it is an attempt to codify the best current practice on screw thread production.

The committee's decision to limit the field covered by its first report to threaded parts for holding purposes, such as bolts, nuts, machine screws, and commercially tapped holes, seems to be well founded. The standard practice codified by this report will first be given a fair tryout by the American screw thread industry and there will be an opportunity for revision or correction if necessary. Later efforts may be made toward further establishment of standards for threading tools and screw threads for special purposes. Among the latter are included studs and fine threads of large diameter and short engagement, as, for instance, those that are used for cap-nuts on machine tool collars, hub and radiator caps, etc. The sectional committee fully realized that the screw thread field is so broad as to make it impossible to cover the entire field in its first report. Furthermore, the experience that it is hoped to gain by the use of its first proposals will be of great value in working out satisfactory standards for other applications.

Since it is impracticable to reproduce in MACHINERY the complete report of the committee, only the table giving the number of threads recommended, corresponding to given diameters, has been included in this article. The report is now being prepared for publication in pamphlet form, and it is expected that these pamphlets will be ready for general distribution by August 15; those who desire copies of this report should apply to the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

NUMBERS OF THREADS PER INCH AND CORRESPONDING DIAMETERS

Size	Basic Major (or Outside) Diameter, Inches	Fine Series, Threads per Inch	Coarse Series, Threads per Inch
0	0.0600	80	..
1	0.0730	72	64
2	0.0860	64	56
3	0.0990	56	48
4	0.1120	48	40
5	0.1250	44	40
6	0.1380	40	32
8	0.1640	36	32
10	0.1900	32	24
12	0.2160	28	24
1/4	0.2500	28	20
5/16	0.3125	24	18
3/8	0.3750	24	16
7/16	0.4375	20	14
1/2	0.5000	20	13
9/16	0.5625	18	12
5/8	0.6250	18	11
3/4	0.7500	16	10
7/8	0.8750	14	9
1	1.0000	14	8
1 1/8	1.1250	12	7
1 1/4	1.2500	12	7
1 1/2	1.5000	12	6
1 3/4	1.7500	12*	5
2	2.0000	12*	4 1/2
2 1/4	2.2500	12*	4 1/2
2 1/2	2.5000	12*	4
2 3/4	2.7500	12*	4
3	3.0000	10*	4

Machinery

*These pitches are suitable for work requiring short engagement where it is not practical to specify tolerances for all conditions.

Form of Thread

The form of thread profile specified is the same as that which has previously been known as the U. S. standard or Sellers thread, but it is proposed that hereafter this thread form be known as the American (National) form of thread. Two thread series are adopted—a coarse and a fine. The coarse thread series is the present U. S. standard thread supplemented in the sizes below 1/4 inch by sizes that were formerly included in the special machine screw sizes adopted by the American Society of Mechanical Engineers. The fine thread series from 1/4 inch to 1 1/2 inches inclusive, is in accordance with the present screw thread series of the Society of Automotive Engineers, supplemented in sizes below 1/4 inch by the standard machine screw sizes (except the No. 10 machine screw) adopted by the American Society of Mechanical Engineers.

Classification of Fits

The report established for general use has four distinct classes of screw thread fits known as loose fit, free fit, medium fit, and close fit. The *loose fit* is recommended as a commercial standard for tapped holes in the numbered sizes only. The *free fit* applies to the great bulk of screw thread work of ordinary quality including both finished and semi-finished bolts and nuts. The *medium fit* includes the better grade of interchangeable screw thread work, such as automobile bolts and nuts. The *close fit* includes screw thread work requiring a fine snug fit, somewhat closer than a medium fit, such as high-class aircraft parts. In this class of fit, selective assembly of parts may be required. It is not considered practicable as a commercial standard for tapped holes of the numbered sizes.

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IMPORTANCE OF SUITABLE SMALL TOOLS

Almost everyone is familiar with the remarkable improvements that have been made in machine tools during recent years. The power of many types of machines has been more than doubled, the rigidity has been increased, and many new features have added to their operating facility. But the machine tool user who installs this improved equipment should remember that, however high the quality of the machine tools, they cannot produce the best results unless careful attention is given to the selection and use of suitable small tools and tooling equipment.

In an address before the Electric Power Club at its annual meeting, R. W. Gardner, vice-president of the Otis Elevator Co., called particular attention to this point. He mentioned that the machining—boring, facing and milling—of a gear-case on a special high-grade machine tool required two and one-half hours, when no special fixture or attachment, other than regular cutting tools, was used. By the use of a specially designed fixture with boring, facing and milling attachments, so that these three operations could be performed simultaneously at one setting, the time was reduced to one-half hour. In other words, the same machine tool was capable of producing 400 per cent more work than it formerly did by the provision of suitable fixtures and tools. In cases where stellite can be used to advantage, it has been found possible to increase the speeds and feeds as much as 70 per cent over those used when high-speed steel is employed. In both cases the same machine tools are used, the increased production being due entirely to the cutting tools.

Many shops could get more out of their machine tools than they do if the men in charge of production would study carefully the possible improvements in the tools and other equipment used in connection with the machines. Some superintendents are satisfied that with the installation of a machine of the latest design, the highest possible production will be obtained; but it is the man who studies fundamentals that recognizes that the machine itself solves only a part of the production problem, and that the methods employed and the tools and equipment used on the machine, are responsible for the other part. By all means use the best machine tools available; but give them a chance to show what they are capable of by providing them with the best tools, fixtures, or other equipment.

* * *

COST REDUCTION BY IMPROVED MACHINERY

It was the general belief at the end of the boom period in the automobile industry in 1920 that the automobile plants were so well equipped and their methods so highly developed that only minor economies could be accomplished by further improvement in the near future. The automobile companies were not regarded as important purchasers of new equipment for some time to come, especially as the prospects for good business in that field were not promising.

But even in that highly developed industry, means were found to reduce costs by improved machinery and methods, and automobile manufacturers were large buyers of machine tools during the latter half of 1921 and in 1922, although there was but little demand for new machinery in other machine-building fields. It is of interest to record the actual savings accomplished by one automobile company through the use of improved machines and methods in a period of two years: In March, 1920, this company built 6126 automobiles with 8216 employes, and considered that a fair output. In May, 1922, the same company built 7147 cars with 4365 employes—an increase in output per man of about 120 per cent. Some of this increase should be ascribed to the greater efficiency of labor. This, of course, is a variable quantity which cannot be estimated in exact figures, but some manufacturers claim an increase of as much as 25 per cent, as compared with the high-pressure period in 1920, basing their estimate on the fact that 75 per cent of the former force now produces about the same output as the entire force did in 1920, without any important changes in manufacturing methods or equipment.

Here are a few recent examples of cost reductions by high-production machinery:

In the manufacture of driving chain, one part produced in large quantities is now made by improved automatic machines at the rate of about 40 pieces per hour, as compared with 8 to 9 pieces by the equipment formerly used. The new machines installed in one shop enabled the manufacturer to so undersell his competitors that when they learned the reason for his reduced costs they immediately ordered similar equipment as the only method of meeting the competition.

A pipe fitting is now machined in 40 seconds on an automatic machine costing $7000, which formerly was produced in 3 minutes on a machine costing $12,000.

A newly developed screwdriving and nut-setting machine proved so efficient, as compared with older methods, that it saved its cost in 3½ months, because one man was able to do the work that formerly required two.

These examples indicate better than general statements the value of the improvements in machine tool equipment developed during recent years. When manufacturers in the machine-building industries fully realize the savings that can be made through the use of modern machine tools, many of the less productive machines of former days will be relegated to the scrap heap and replaced by new machinery.

* * *

UTILIZING TIME AT CONVENTIONS

Often the most valuable ideas carried away from an industrial convention are developed from the discussions of the papers read; but intelligent discussion of such papers usually requires some preparation, and for this reason considerable time could be saved if the papers to be presented were printed or mimeographed and distributed to the members a week or two in advance, as is done by the American Society of Mechanical Engineers. If this were done generally, not only would considerable time be saved, but many good ideas would be brought out during the discussion. As the members interested would have an opportunity to acquaint themselves with each paper before its presentation to the convention, it would not need to be read in full there, but a summary might be presented covering the essential points. More time could then be devoted to intelligent discussion, the interest of the convention would be more easily sustained and more value would be received for the time given.

The preprinting or mimeographing of convention papers adds somewhat to the cost, but this addition would be only a small percentage of the total expense, and as it makes possible the use of the time at the meeting to better advantage and facilitates the interchange of ideas, the money would be well spent.

MACHINE TOOL STANDARDIZATION

There are a great many difficulties to be overcome in bringing about such standardization in the machine tool industry as has been declared desirable by many of the manufacturers in this field as well as by the users of machine tools. It is evident that it is a serious matter to make changes in existing designs, and many manufacturers of machine tools, although they recognize the value of standardization, hesitate to commit themselves to any radical changes in their product in order to conform with similar products made by other manufacturers.

There is, however, a field of standardization that would prove profitable to the manufacturer as well as to the user, without involving too radical changes in present practice. This field of standardization is within the complete control of each manufacturer, and consists in standardizing his own product to such an extent that, where he builds several types or sizes, the number of parts may be reduced to a minimum. Some comprehensive standardization work in this direction has been carried out by the Jones & Lamson Machine Co., Springfield, Vt. The design of the turret lathes built by this company has been so standardized or unified that eight specific machines, providing a range that covers the majority of all bar and chuck work in the average machine shop, can be built up from a small number of separate units, as follows:

3 Beds	1 Feed Mechanism
2 Headstocks	1 Apron
1 Driving Mechanism	3 Turret slides
3 Spindles	3 Turrets

In addition to this, many of the parts of the driving mechanism are reduplicated; for example, all the clutch members in a given headstock are identical, except for the thickness and the number of the friction disks.

A number of important advantages accrue to both the manufacturer of the machines and the user from standardization of this kind. It is evident that if eight different types or models can be built from units that are the same for several or all of the machines, it is possible to reduce manufacturing costs, so that a machine of the same quality can be sold at a lower price, and yet will provide a more substantial return to the manufacturer. A machine tool builder who so unifies the design of his machines that he can build certain units in quantity and yet has a wide range of types to offer can include improved details of design, such as ball bearings, heat-treated gears, and many other features that are essential in a high-grade machine, without increasing the cost; because, owing to the larger production of unit parts in a standardized design, the cost of the machine can still be held within reasonable limits.

A larger number of types of machines can be provided than would otherwise prove economical, and in this way the range of work for which the line of machines is suitable can be increased without increasing the price of the machines. Thus machines that would otherwise be considered special are produced at the same price as a standard line. Furthermore, the different types of machines built by one maker, when constructed according to the unit system of standardized design, will be similar in many respects, and there will be a smaller number of parts to deal with in case of repairs. The problem of management in the user's shop is therefore greatly simplified, and the men in the shop will become more readily familiar with the upkeep and adjustment of a complete line of machines. In large shops, where repair parts are carried in stock, a smaller number is required. This applies, in fact, both to the machine tool builder's stock and to the users.

Furthermore, by standardizing a line of machine tools built by one maker, the problem of teaching the workmen in the user's shop to adjust and operate an entire line of machines will be materially simplified. A man once trained on one machine of a given make will be able to operate, with equal facility, a number of other types of machines of the same make. The training itself can be standardized, and the men can be more easily taught proper methods of running and adjusting the machines. All of this reduces costs, makes changes in personnel less serious, and creates a smoother running organization.

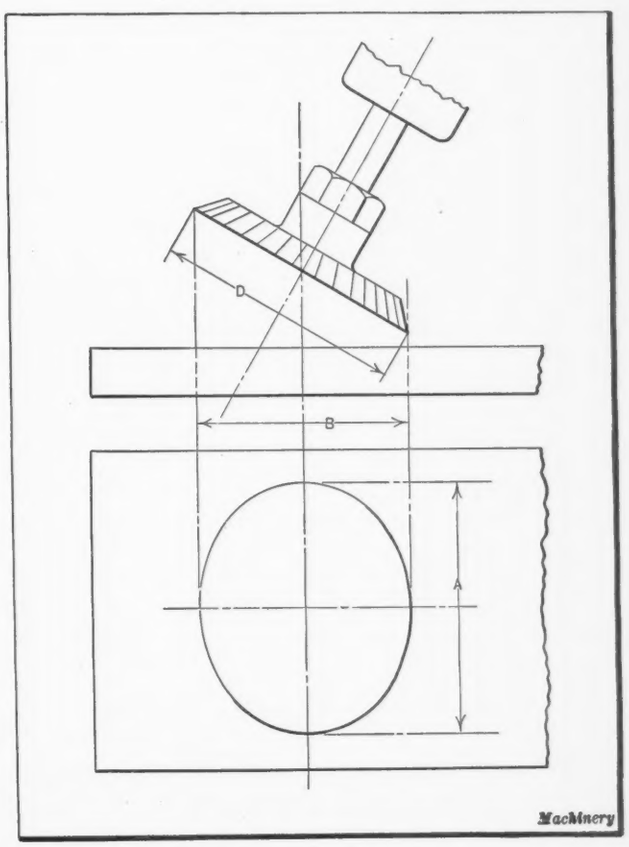
During the last two years, when the production in machine tool shops has been far from capacity, a good deal of attention has been given to standardization problems affecting the products of the shops, and this is a great step forward in standardization in the machine tool field. It is a case of beginning at home to develop standards of design, and later, cooperation between machine tool builders may carry this movement to still greater lengths for the benefit of both the machine tool manufacturer and the user.

* * *

MILLING AN ELLIPTICAL HOLE IN A STEEL PLATE

By G. A. LUERS

A method of cutting an elliptical hole in a steel plate is shown diagrammatically in the accompanying illustration. If a solid cutter like the one shown is used, the diameter *D* must be equal to the major axis *A* of the hole. The milling head is tilted so that when the work is fed upward in a vertical direction the cutter will mill a hole having the required minor axis *B*. The face-cutting teeth would remove the metal at the center of the hole if they could be extended to the center of the tool, but as this cannot be

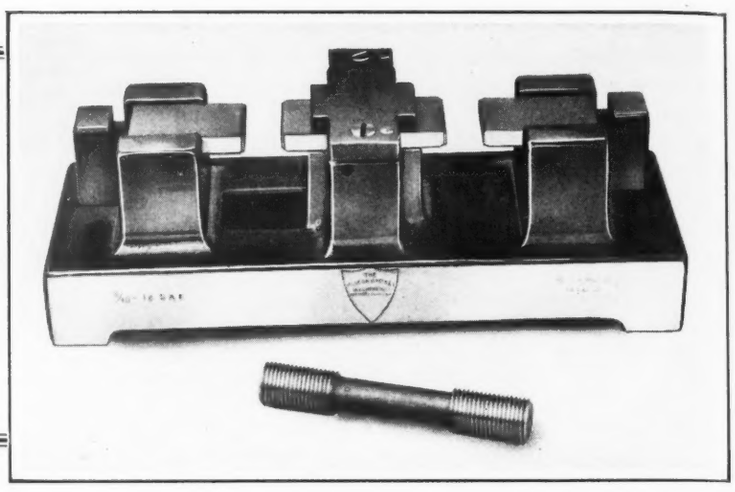


Method of milling Elliptical Hole

done, it is necessary to remove most of the metal by boring or drilling, if the work is 1/16 inch or more in thickness. Thinner stock will bend in some cases in advance of the tool so that no hole need be cut previous to the milling operation. The work is clamped to the milling machine table on parallel bars, or held in a fixture that will permit the cutter to pass through far enough to finish the hole completely at one setting. An adjustable fly cutter may be used in place of the milling cutter if desired, or if a milling cutter of the right size is not available.

Thread Measuring Devices

By B. M. W. HANSON, President
Hanson-Whitney Machine Co., Hartford, Conn.



IN determining upon tolerances for screw thread fits, it is of the greatest importance that the tolerance on the pitch diameter be considered in connection with the tolerance on the lead of the thread. Many people well versed in mechanics in general simply consider the tolerance on the pitch diameter and seem to believe that that is all that is necessary. As a matter of fact, in practice, the least important dimension of a screw thread is the pitch diameter, and the most important is the lead; because no matter how accurate the pitch diameter is, this accuracy is valueless if the lead is incorrect. This subject has been dealt with by the writer in a previous article in MACHINERY, and is also thoroughly explained in a book entitled "Handbook of Small Tools," by Erik Oberg. Notwithstanding the publicity that has been given to this subject, there still seems to be a lack of understanding of the relation existing between the tolerances on pitch diameter and on lead, and the effect of the length of the nut.

Importance of Correct Thread Angle

The angle of the thread is not accorded the importance that this important detail of the tap or screw merits. The writer considers the accuracy of the angle of the thread to be next in importance to the accuracy of the lead. Furthermore, it is much easier to obtain accuracy of pitch diameter than it is to obtain accuracy in lead and in the angle of the thread. A screw thread may have a very accurate pitch diameter and be quite accurate in lead, and yet, if the angle is incorrect, it will have an imperfect bearing in the nut.

Many attempts have been made to establish tolerances both for pitch diameters and lead errors, and while this work is commendable as far as it goes, such tolerances are of little real value unless means are provided for accurately measuring the different factors that enter into a correctly produced screw thread. The writer has therefore concentrated his attention on the design of measuring devices for maintaining established tolerances on screw threads.

The heading illustration shows an inspection gage by means of which what might be called the "combination tolerance" on pitch diameter and lead may be established, and work measured to determine whether it is within the established tolerances. This device consists of two jaws, which are solidly held after having been adjusted, one at the extreme right and one at the extreme left. In the middle is a single, double-ended jaw, which is positively held against movement in a longitudinal direction, but which is free to float crosswise of the measuring device, so that the threads in its face can adjust themselves to the thread grooves of any tap or screw being measured between the floating and the solidly held jaw.

In the foreground of the illustration is shown a double-ended plug thread gage which is part of the measuring system, one end of this plug being made to the maximum size of the screw to be tested, and the other end to the minimum size. This plug thread gage is used for adjusting the solid jaws of the inspecting gage, so that the gage will be set to maximum and minimum dimensions.

In use, this inspecting gage is placed on a bench, and large quantities of screws can be quickly inspected, as they should pass freely through one set of gage jaws and not pass through the other set at all. This gage has the advantage that even though the pitch diameter is correct, it will not pass screws that have too great an error in lead, because the combination of lead and pitch errors would prevent the screw from entering the nut for which it is intended, with a proper bearing in the threads, as already mentioned.

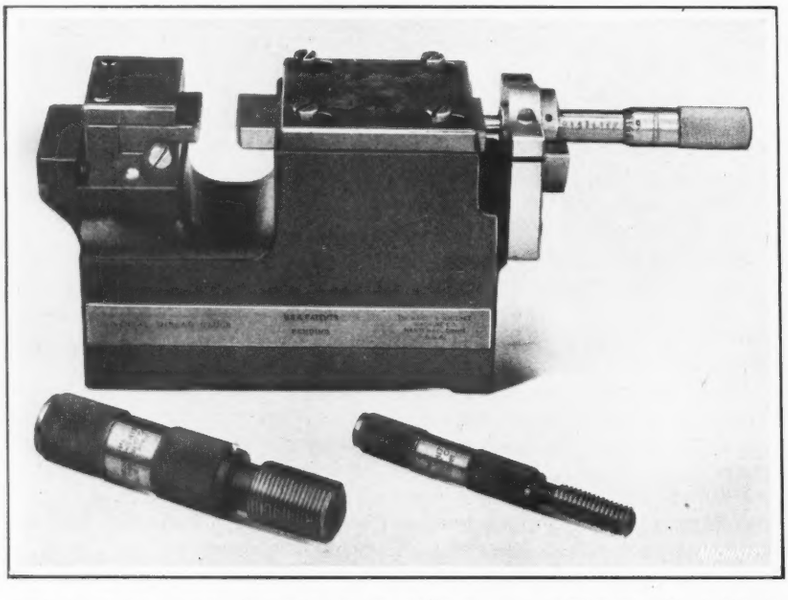


Fig. 1. Thread-measuring Device showing Combined Accuracy of Pitch Diameter and Lead

Fig. 1 shows a thread-measuring device, the object of which is to detect errors in lead as well as to measure pitch diameters. This gage has two jaws; the one at the right is operated by a micrometer screw and the one at the left is held positively as regards longitudinal movement in the direction of the micrometer screw, but it can float back and forth crosswise of the measuring device so that the threads in the jaw will accurately fit into the threads of

the gage, tap, or screw being measured. The sub-frame of the floating jaw is also capable of swiveling, and two adjusting screws are provided in the rear so that it may be set very accurately in a position parallel with the other jaw. The jaws can be easily removed from the gage body and other jaws substituted for measuring different pitches of thread.

In the foreground of this illustration two plug thread gages are shown, ⅜ and ¾ inch in diameter, respectively. These gages will serve as an example of the use of the instrument. They are of the same pitch, the diameters only differing. The micrometer readings are so adjusted that when the ¾-inch plug is inserted, the micrometer will read ¾ inch, and when the ⅜-inch plug is put in position, the micrometer will read ⅜ inch, although the measurement is not taken over the tops of the thread, but in the actual angle of the thread.

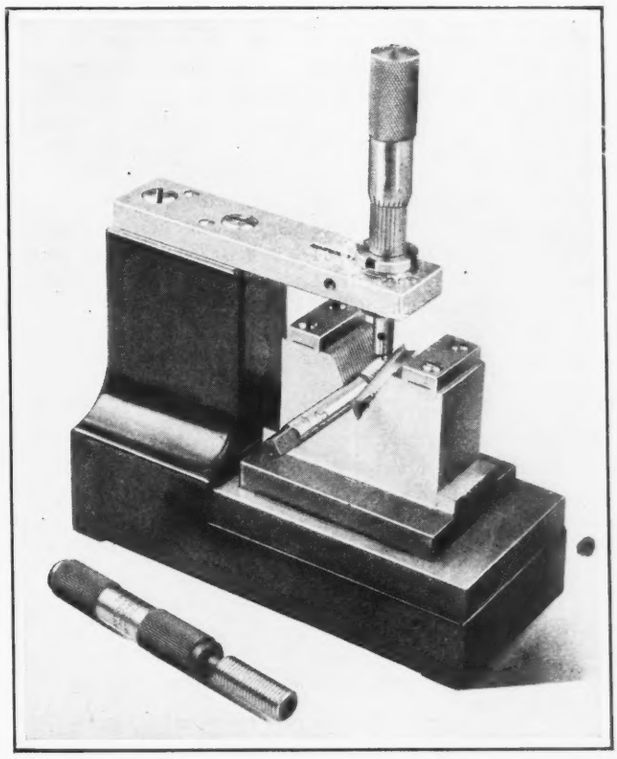


Fig. 2. Measuring Device for Taps with Odd Numbers of Flutes

The threads in the jaws are accurately ground to the correct angle and are very accurate in lead, so that when they engage with the threads of the object to be measured, errors in lead, as well as in the form of the angle of the thread, can be observed by visual inspection, and the combined error of inaccuracies in lead and pitch diameter will register on the micrometer reading.

In order to prove whether or not the lead is accurate, the object to be measured is first engaged the full length of the jaw, and afterward engaged about two threads only, and measured. If the lead is correct, the micrometer reading should be the same in both cases. If the lead is incorrect, the reading will be larger when the gage jaws are engaged for the full length. This method of measurement, therefore, will show whether or not the lead is correct, and it will also give the total effect on the pitch diameter of the error in lead in a length equal to the width of the jaw. A table may be provided that will show what the actual error in pitch diameter is for jaws one inch wide, and various micrometer readings.

However, as the fit of the nut depends not upon the pitch diameter alone, but upon the combined effect of errors in pitch diameter and lead, the real measure of the tolerance of the screw thread is the actual micrometer reading, which, as mentioned before, may be termed the "combined tolerance."

Gage for Measuring Taps with Odd Numbers of Flutes

Fig. 2 shows a measuring device by means of which the correct diameter and lead of a three-fluted tap may be gaged. This device has two jaws inclined toward each other at a 60-degree angle. The jaws are hardened, and the threads are finished by grinding, the thread grooves corresponding accurately to the lead or pitch of the tap to be measured. In the past there has been no satisfactory means for measuring taps with an odd number of flutes, and as this style of tap is a necessity for many classes of work, a device for measuring diameters of such taps is of considerable value. For a five-fluted tap, the angle between the jaws is, of course, different from the angle used for a three-fluted tap.

The micrometer of this gage is so graduated that it reads directly the diameter being measured, compensation being made in the micrometer graduations for the angle of the gage jaws. In addition to measuring pitch diameter, this device indicates errors in the lead or angle of the thread, based on the same principle as that by which the combination errors of lead, angle, and pitch diameter are found in the devices previously described. It is evident that if the lead is inaccurate, the tap will not fit or sink down to the full depth of its thread in the jaws, and hence the micrometer reading will be correspondingly larger.

Lead Measuring Machine

Fig. 3 shows a new lead measuring machine which has been designed with a view to providing a simple lead measuring device of great accuracy. Simplicity of operation has been one of the main considerations in its design, and the effect of the personal element of the man taking the measurement has been removed. After brief instruction, anyone can accurately measure lead errors by this device. This machine is constructed somewhat on the principle of the well-known Pratt & Whitney measuring machine, but, in addition, it has a multiplying device with compound levers pivoted on points such as are used in high-grade weighing scales.

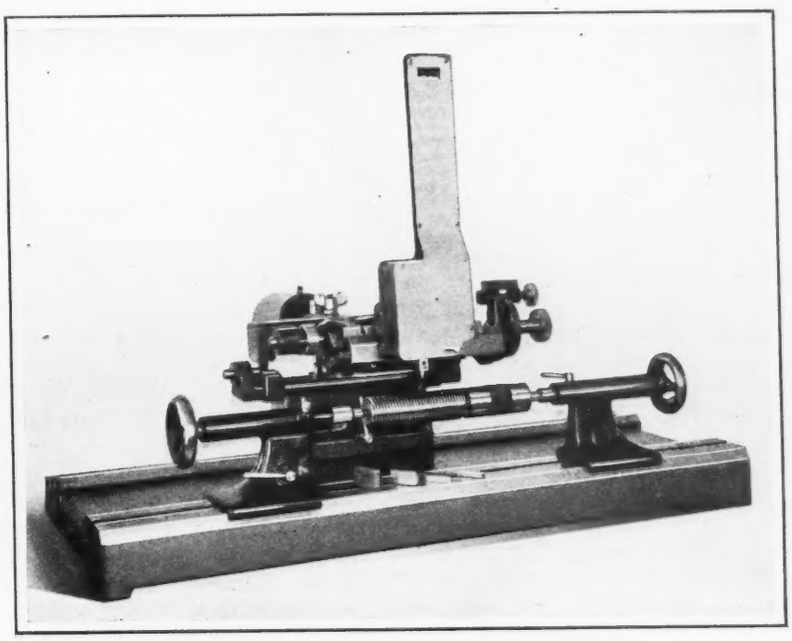


Fig. 3. Lead Measuring Machine

The illustration shows a threaded plug between the centers of the device. One of the centers is provided with a spring so that parts to be measured can be easily put in and taken out by simply pushing the center backward. Immediately above the plug to be measured will be seen a holder for a ball point that enters in the thread groove. At the extreme upper end of the bracket attached to the front of the device there is a window, inside of which is a graduated scale, each graduation representing 0.0001 inch. As the lever multiplies 150 times, each graduation is approximately 1/64 inch, which is amply large enough to enable even one-half of a ten-thousandth of an inch to be easily read with the naked eye.

The application of the device is simple. After the threaded plug, tap, or screw has been put in place between the centers, the ball point is brought down until it rests in a thread groove, and then the slide carrying the bracket with the ball point and the lever mechanism is adjusted until the pointer reads zero on the scale at the top of the bracket. The exact location of the measuring machine part of the device is determined the same as in a Pratt & Whitney machine by means of a feeler piece which drops by its own weight when the correct amount of pressure has been applied in the setting.

Now the slide is moved an exact predetermined distance—½ or 1 inch, as the case may be. The setting in the new position is determined by inserting a Johansson gage-block between the measuring surfaces in the rear of the device. The exact setting is determined by first locating the slide approximately, and then adjusting it slightly until the feeler piece falls by its own weight. This indicates that the slide and consequently the ball point, has been moved exactly either ½ or 1 inch. The ball point is now again brought down into the thread groove. If the lead is exactly correct, the pointer will remain at zero. Any error in the lead will be shown by the pointer moving a certain distance either to the right or to the left, and the amount of error in the lead—plus or minus—is determined at a glance.

The device is so counterweighted that the ball point is normally out of contact with the thread to be measured, but it is brought down into contact by a simple movement of the hand, which swings the entire mechanism forward. The lower of the two knurled-head screws shown to the right is for quick adjustments of the slide, and the upper screw, which engages with the stem or shaft of the lower one by means of a gear and pinion, is used for the fine adjustment necessary to actuate the feeler piece.

There are many refinements in design involved in this mechanism, but the outline of its operation, as given in the foregoing, explains the main principles involved. For combined simplicity of operation, accuracy and sensitiveness, it is believed that this lead testing device will meet practical requirements more fully than has previously been possible.

* * *

HYDRAULIC PRESSURE INTENSIFIER

By JOHN N. SIOUSSA

Hydraulic equipment for producing pressures greater than 25,000 pounds per square inch is required in comparatively few industries. A careful investigation by the writer revealed the fact that little is generally known or has been written about the design of hydraulic equipment for pressures above 30,000 pounds per square inch. Recently there was need in a certain plant for equipment capable of producing a pressure of 125,000 pounds per square inch, and the intensifier shown diagrammatically in Fig. 1 was built to meet this demand. The design is simple, and has given satisfactory results. It can be operated at small cost, and its productive value is high.

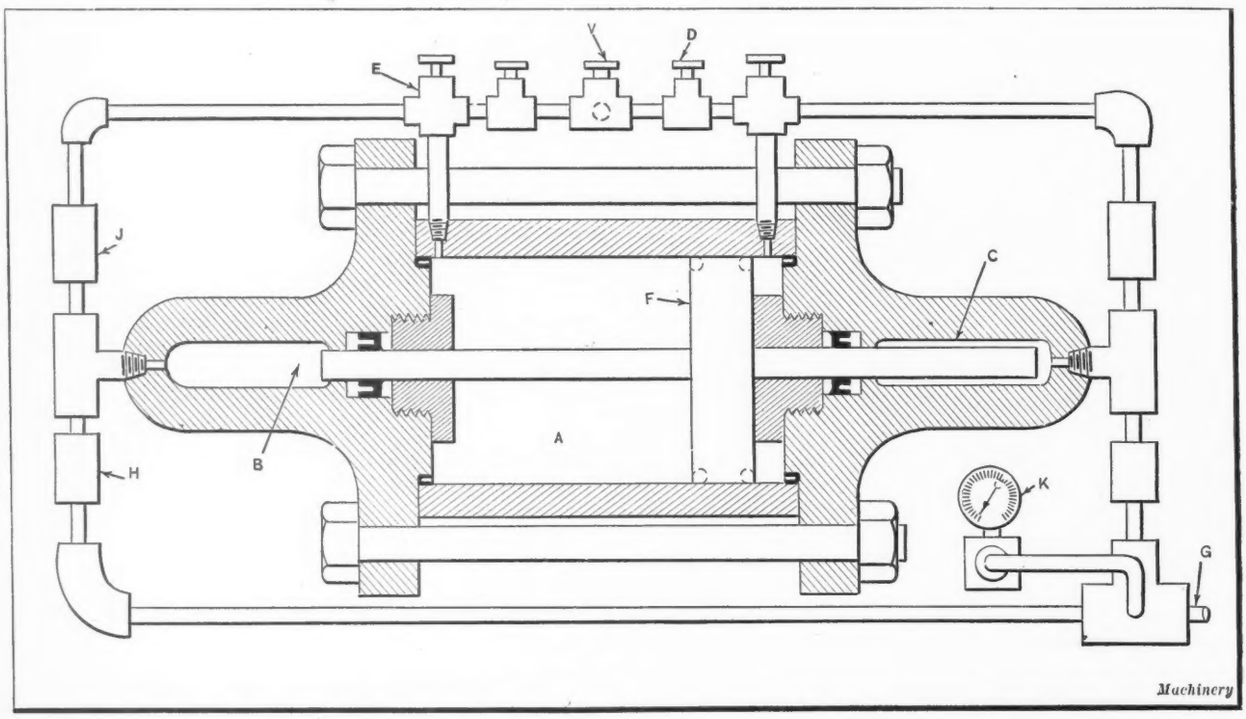


Fig. 1. Hydraulic Intensifier for obtaining a Pressure of 125,000 Pounds per Square Inch

Commercial hydraulic pumps having a capacity of about 5000 pounds per square inch are used to operate the hydraulic intensifier. The diameters of the differential pistons of the intensifier are in the ratio of 25 to 1. The low-pressure cylinder *A* is located between two high-pressure cylinders *B* and *C*, which are secured to the ends of the low-pressure cylinder by bolts, as shown. The piston-head is fitted with a plunger at each end. These plungers compress the liquid in the high-pressure cylinders. The intensifier is double-acting; in other words, while the liquid in one cylinder is being compressed and forced into the delivery pipe, the liquid is being admitted or drawn into the other cylinder so that it will be filled, ready to be compressed on the return stroke.

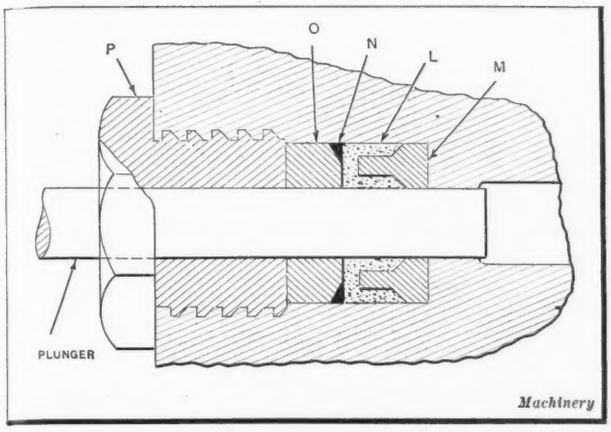


Fig. 2. Packing used to prevent Leakage between High- and Low-pressure Cylinders

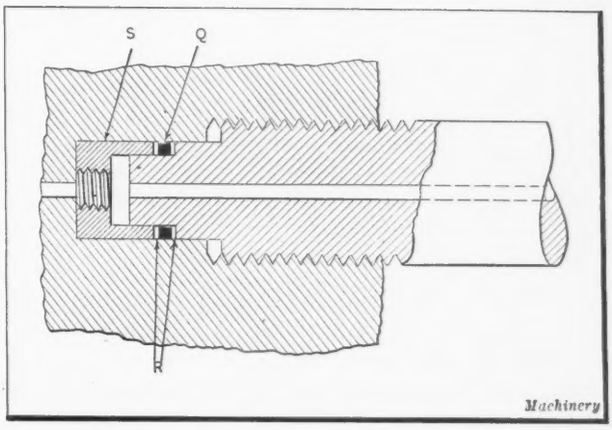


Fig. 3. Sectional View of Pipe Connection of High-pressure Equipment

The supply from the hydraulic pumps at a pressure of 5000 pounds per square inch is connected to valve *V* and admitted to the right-hand end of low-pressure cylinder *A* through pressure valve *D*, while drain valve *E* at the other end of the cylinder allows the exhaust liquid to flow back into the supply tank. As piston *F* is forced to the left, the liquid in the high-pressure cylinder *B* is compressed and forced into the delivery pipe *G* through check-valve *H*, which also prevents the liquid from flowing back into the high-pressure cylinder. On the return stroke the high-pressure cylinder *B* is refilled from the delivery pipes of the low-pressure pumps, and the check-valve *J* on the low-pressure side prevents the liquid from returning when the piston reverses and repeats the operation. The high-pressure cylinder *C* is filled from the low-pressure supply, and exhausts into the high-pressure delivery line in the same manner as cylinder *B*. The dial gage *K*, which is attached to the high-pressure delivery pipe as shown, indicates the pressure at which the liquid is being discharged from the intensifier.

Provision for Preventing Leakage

The packing used on the piston *F* and the cylinder head is of the common U-shaped type, and is subjected to a pressure of only 5000 pounds per square inch. In the high-pressure cylinders the packing is somewhat different from that used in the low-pressure cylinder. Fig. 2 shows the method employed to prevent leakage between the high-pressure and the low-pressure cylinders. This method of packing is one of the features of the equipment that have made it possible to obtain safely pressures of 125,000 pounds per square inch. The leather packing of the high-pressure cylinder is shown at *L*. This is made from the best grade of leather, specially treated in a bath of hot tallow and beeswax to adapt it for use in hydraulic equipment subjected to high pressures. The treatment given this packing supplies the necessary lubricant for the plunger, and also prevents the liquid from being forced through the leather.

As indicated in the illustration, the packing is formed with lips of the usual length, the ends being trimmed uniformly at a slight angle. The thrust face is flat, and the corners are square and sharp. A retaining ring *M* is used to keep the packing in position, and an expanding ring *N* prevents the packing from flowing between the wall of the packing chamber and the gasket *O*. It will be noted that the cross-section of the expanding ring *N* is triangular in shape. The angular position of the contacting faces of the packing and of the lead gasket *O*, together with the carefully beveled joining ends of the expanding ring *N*, provides for the expansion required to prevent leakage when the inner walls of the packing chamber become dilated under the extremely high pressures developed.

The nut *P* securely holds the parts *L*, *M*, *N*, and *O* in place. Nut *P* is secured by a differential buttress thread; this form of thread has great strength and the differential pitch provides for the proper distribution of the thrust load over the entire thread, so that no single thread will be overstressed. As the pressure builds up, each thread takes up its part of the load gradually, until the highest pressures are reached.

Pipe Connections

The joints or connections used for the tubing and fittings that convey the liquid under high pressure were designed as shown in Fig. 3. Unusually heavy tubing and fittings were, of course, required, to withstand the extremely high pressures. The screw threads used for the coupling joints were of the type approved by the National Screw Thread Commission. Steel washers *R* were placed on each side of the lead gasket *Q*. One of the steel washers bears against the end of the gland cup *S*. Under the pressure of the screw joint, the lead composing gasket *Q* is forced to flow and thus seal the joint so that it is absolutely leakproof.

The check-valves used were of the ball type, as shown in Fig. 4, a small steel bearing ball *T* being used as a check. The ball seat was ground and lapped to a spherical shape to fit the surface of the ball. A cage *U* was incorporated in the check-valve so as to keep the ball close to the seating surface. Needle valves of special design were employed in order to provide a means of gradually releasing the pressures.

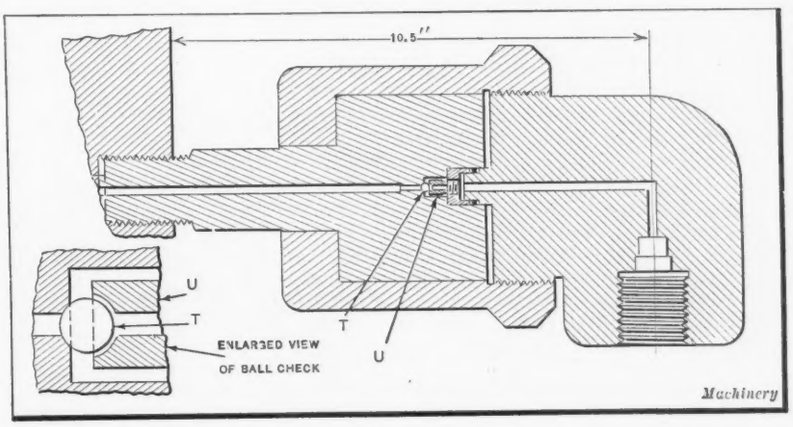


Fig. 4. Sectional Views of Ball Check-valve such as indicated diagrammatically at J and H, Fig. 1

INDUSTRIAL CONDITIONS IN GERMANY

From MACHINERY'S Special Correspondent

Berlin, July 9

Conditions in Germany change so rapidly from day to day that a statement as to the present conditions may not apply by the time this letter is printed and read. The Ruhr occupation is, of course, the one important feature in the entire situation. At the beginning of the occupation it was expected that the lack of coal and coke would prove an extremely serious handicap, but the condition is not so bad as was expected. There has been considerable importation of British, American, and South African coal, and this, together with the fuel from the non-occupied districts, has enabled the machine-building industries to keep going up to the present time. The industry is not running at the high pressure that it did in 1922, owing to lack of orders, and hence the lack of raw materials has not been so severely felt as was expected.

The Machine Tool Industry

There has been a great reduction in the exports of machine tools, present exports being hardly one-half the pre-war business. Other retarding factors in the machine tool industry are the high prices of castings, the scarcity of young skilled workers, and the difficulty in quoting prices that will meet the steady decline of the mark. It is evident that when payments are made by installments, a very difficult problem arises, because the mark may have a much greater value at the time one installment is paid than it has when the next is due. Methods have been devised for taking care of this trouble, but nevertheless, great difficulties are naturally experienced when a medium of exchange is used that varies so tremendously from week to week, and even from day to day.

One of the difficulties in the foreign market is that at the present time German manufacturers are not able to meet the prices of their foreign competitors. For example, Danish lathes are offered in Finland 15 per cent cheaper than those built by German makers. French twist drills have been sold in Finland for one-quarter the price quoted by German manufacturers. The foreign trade in automobiles is practically cut off for the same reason; American automobiles are offered at prices much lower than those that German manufacturers ask.

Among the few firms that report activity are Ludwig Loewe & Co., whose volume of business has been greater than in 1922; the works have been fully occupied on current orders. The Wotanwerke A. G. of Leipzig has also been working to capacity in all departments, and the Pittler Werkzeugmaschinenfabrik of Leipzig has been fully occupied until quite recently, although the booking of new orders has been slow. The R. Stock A. G. Spiralbohrer & Werkzeugfabrik of Berlin-Marienfelde is also reported to have plenty of orders on hand. But these firms are among those that are in an unusually good position and are not representative of conditions in the German machine tool industry, because the average shops are now working short hours and are hampered by lack of business, curtailment of credit, and scarcity of raw materials.

The Automobile Industry

Of all the German machine-building industries the automobile building plants are best occupied at present. Naturally, with the mark constantly falling in value, nobody keeps money, but exchanges it as soon as possible for some form of goods. This has aided the automobile industry in that many have bought automobiles with their available cash, rather than keep it and see it constantly decrease in value. In some cases, the owners of the new cars are unable to pay for gasoline for the continuous running of the car, but nevertheless they feel that they are better off having their money in a concrete piece of property. At the present time, there is one automobile in Germany for each 360 inhabitants. Many new developments have been made in the automobile industry, and efforts are especially being made to improve the design with a view to decreasing air resistance, in order to increase the gasoline mileage.

General Industrial Conditions

In business circles, combinations or trusts are still being formed, and there is a tendency to combine the production of raw materials and finished products under the same management. One recently formed combination, for example, controls coal, steel mills, and machinery-building establishments. A great many foreign enterprises have been organized by German concerns. It is said that the firm of Hugo Stinnes owns over one hundred foreign industrial concerns, not including the foreign branches of the Siemens-Rhein-Elbe-Schuckert-Union. The Algemeine Elektrizitats Gesellschaft has eighty foreign branches, and a great many of the other large German companies are operating mining concessions, factories, or branches in foreign countries. The trade with Russia has not developed to any important extent, the business with that country suffering mainly from the utter lack of buying power in Russia.

Labor conditions are no longer so good as they were last year. Many of the industrial workers have had their hours reduced, and the number of workers without employment increases from week to week. The lack of employment applies especially to the smaller plants, and from Saxony, the industrial center of Germany outside of the Ruhr district, reports of the dismissal of workers in factories are frequent. Locomotive and car shops are suffering from lack of business, and in the shipbuilding industry there is no new construction to speak of, most of the yards now doing only repair work. The work on new ships has been suspended on account of lack of materials, owing to the cutting off of supplies from the Ruhr district. There have been no serious labor difficulties, and those that have taken place have largely been caused by the increases in prices, which have mounted faster than wages. Most of them have been settled in a friendly way. The only serious strikes that have taken place have been those of a political character, fomented by the communists.

* * *

EASY METHOD OF READING A CHART

By N. G. NEAR

Considerable time is often spent in locating the edge of a ruler or straightedge on the points that represent the known values on two different graduated lines of a chart, so that an unknown point may be located on a third graduated line by the edge of the ruler. The difficulty lies in locating the straightedge on the two separate points at the same time. The third point, which represents the value to be found, is, of course, in line with the other two points and can be quickly and accurately read if the straightedge is properly located. Now if means are provided for separately locating the straightedge at the known points on the two first-mentioned scales or graduated lines, the work will be greatly facilitated.

This may be accomplished by using a simple device consisting of a soft pine stick, or handle, about the size of a lead pencil, which has a fine needle driven into one end and a fine black silk thread with a knot tied on the end threaded through the eye of the needle. The needle should project about ¼ inch beyond the end of the stick. With this device, the head of the needle is placed on whatever point is selected on the first graduated scale, and the free end of the thread swung around until it is located over the second point. The third point is thus immediately and accurately located. It is a good plan to make a mark of some kind on the stick, so that it can be seen at a glance if it is held so that the eye of the needle is correctly positioned.

Cutting Instrument Gears

Production of Small Gears by Means of Hand-operated and Automatic Machines of the Formed-cutter and Hobbing Types—First of Two Articles

By FRANKLIN D. JONES

GEARS of the small precision class used for various kinds of measuring and recording instruments, pressure gages, meters, vending machines, clock mechanisms, etc., are produced by three general methods, the selection of which depends upon the size of the gears and the quality desired. One method is to form the gear teeth by some cutting process such as milling or hobbing; another is to use a sub-press die; and a third method is to form the teeth by a drawing process, as applied to the production of pinions in rod form.



Fig. 1. Cutting a Stack of Small Gears on a Hand-operated Machine

When the teeth are milled, it is common practice to use a die for cutting the plain blanks from flat stock of the right thickness. These die-cut blanks may or may not be turned before the teeth are cut, the practice varying for different classes of work. Many gears, especially if small and quite thin, are placed in the gear-cutting machine just as they come from the dies; but when comparatively thick stock must be used, the die-cut blanks are often turned to size, although in either case the blank may be left slightly oversize in order to allow for a "topping cut." In other words, there is a slight allowance on the blank diameter to permit finishing the tops of the teeth in the gear-cutter. This practice is quite common in cutting precision gears for instruments, meters, and similar classes of work.

Small precision or instrument gears that have the teeth formed by a cutting process are cut either on machines using a formed cutter, the shape of which is reproduced in the gear tooth, or on machines of the generating type, using hobs. The machines using formed cutters may be controlled by hand or may be automatic.

While different designs of automatic and semi-automatic machines have been developed for cutting small precision gears, it is the practice at the plant of D. S. Plumb, 73 Norfolk St., Newark, N. J., to use hand-operated machines for cutting most of the precision gears. These machines are simple in design, and by their use, gears can be cut very rapidly, notwithstanding the fact that the machines are hand-controlled.

A general view of one of these machines is shown in Fig. 1. The gear (or stack of gears) to be cut is carried



Fig. 2. Rapid Method of turning Small Instrument Gear Blanks

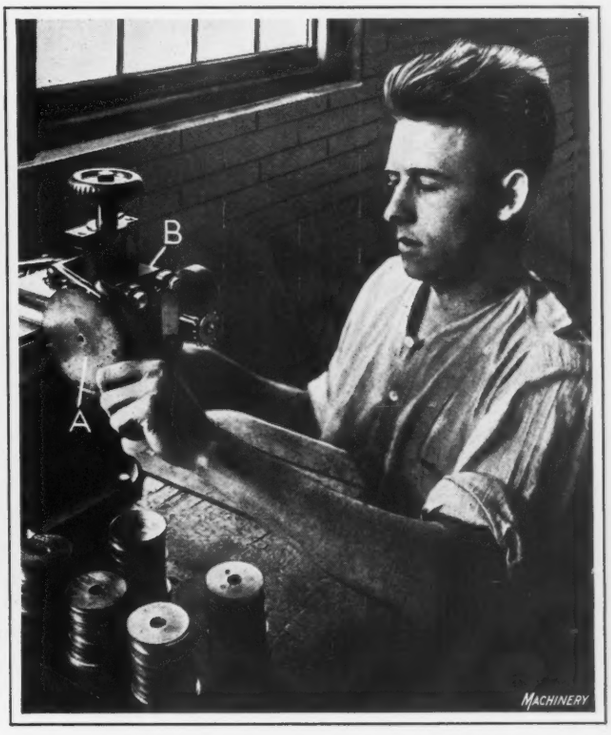


Fig. 3. How Indexing is controlled by Hand on Machine in Fig. 1

by a spindle having at the rear end an index-plate *A* (see Fig. 3) with notches corresponding to the number of teeth required. This spindle is mounted in a quill, which, in turn, is clamped in a V-shaped groove on vertical slide *B*, which provides adjustment to suit the gear diameter and depth of cut. This vertical slide also has lateral adjustment to permit centering the work relative to the cutter, and it is carried by a main slide which can be moved at right angles to the axis of the cutter-spindle by a hand-lever. The cutter-spindle is supported by a fixed bearing, and is driven by belt from a countershaft at the rear of the machine.

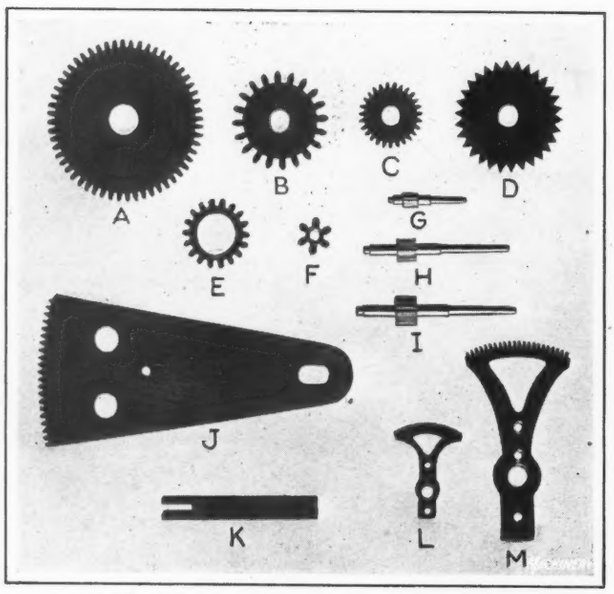


Fig. 4. Samples of Instrument Gears cut on Hand-operated Machines

When this machine is in use, the operator feeds the blank (or blanks) across the cutter by the hand-lever on the right-hand side, and after each tooth space is milled and the slide withdrawn, the work-spindle is indexed to the next notch by using the left hand. The method of holding the work depends upon its shape. For instance, small instrument pinions cut integral with a staff or shaft would be cut one at a time while held between some kind of supporting centers. On the other hand, flat blanks would be stacked on an arbor to permit cutting quite a number in one operation. The hand-controlled feeding and indexing movements are executed so rapidly that a high rate of production is obtained, as indicated by the following specific examples of gear-cutting practice on these machines. While other types have been used, the hand-operated machines are considered the best for most of the precision gear-cutting operations at this plant, as regards both quality and quantity.

Examples of Precision Gear Cutting

The examples of instrument gear work shown in Fig. 4 are from the plant of D. S. Plumb. All these pieces were machined on the hand-operated machines just referred to, and they illustrate in a general way not only the variety of gear-cutting done on these machines, but the rates of production for different classes of work. Gear *A* has 60 teeth, of 36 diametral pitch, and is cut at the rate of 100 per hour. Gear *B*, which is used in a meter, has 20 teeth and is cut at the rate of 300 per hour. This gear is made of No. 16 gage stock. Gear *C* has 26 teeth, of 52 pitch, and a ⅛-inch face. The cutting rate is 250 per hour. The escapement wheel shown at *D*, which is 1 inch in diameter and has 30 teeth cut in it, is turned out at the rate of 250 per hour.

It will be understood that in most cases several blanks are cut at the same time, although this is not always practicable, as shown by some of the examples to follow. Pinion gear *E* has 18 teeth, of 32 pitch, and 180 pinions are cut per hour, five being placed on the arbor at one time. Pinion gear *F* has 6 teeth, of 24 pitch, and is cut one at a time at the rate of 140 per hour. Pinions of the type illustrated at *G*, *H*, and *I* are cut one at a time. Pinion *G* has 13 teeth, of 125 pitch, a 5/32-inch face width, and the cutting rate is 150 per hour. Pinion *H* has 18 teeth, of 90 pitch, a 3/16-inch face, and is cut at the rate of 100 per hour. Pinion *I* has 16 teeth, of 64 pitch, and is cut at the rate of 100 per hour.

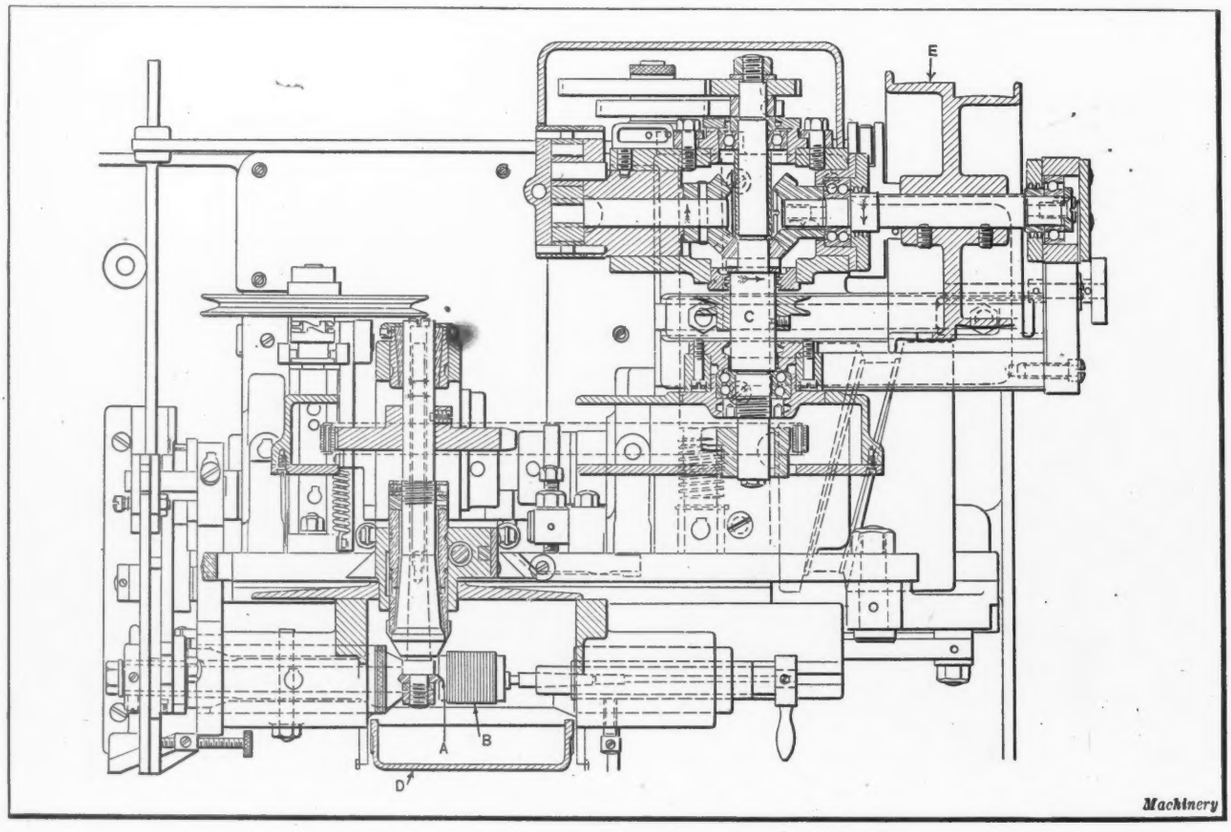


Fig. 5. Plan View of Machine for cutting Spur Gears up to 4 Inches Pitch Diameter

In cutting the segment gears *J*, ten are placed on one arbor. These segments have 21 teeth, of 48 pitch, and are made of No. 11 gage stock. The rate of cutting is 100 per hour. The nickel-silver racks *K* are cut five at a time, at the rate of 80 per hour. These rack teeth have a linear pitch of 0.049 inch. An example of very fine gear-cutting is shown at *L*, the gear teeth being only 150 diametral pitch. These segments are cut at the rate of 260 per hour. Segment gear *M* has 22 teeth, of 64 pitch, and the rate is 300 per hour.

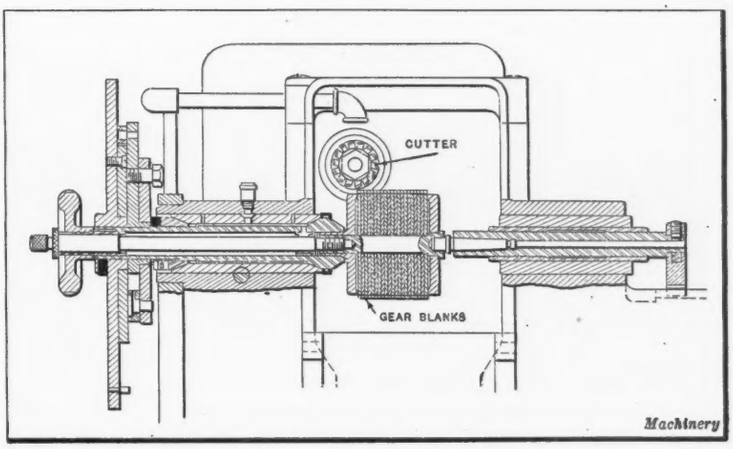


Fig 6. Method of holding Stack of Gear Blanks on Machine illustrated in Fig. 5

An idea of the rate at which blanks can be turned on this simple machine may be obtained from the following examples: Brass blanks for meter gears 15/16 inch in diameter, made of No. 16 gage stock, are turned at the rate of 600 per hour. In doing this work, fourteen blanks are placed on the arbor at one time. Blanks 5/8 inch in diameter, made of No. 8 gage stock, are turned at the rate of 500 per hour, six blanks being placed on the arbor at a time. This machine does not only rapid but also accurate work.

Special Machines for Turning Small Gear Blanks

The special type of lathe illustrated in Fig. 2 is used at the plant previously referred to for turning small gear blanks prior to cutting the teeth. These small lathes are exceedingly simple in their arrangement, but they make it possible to obtain a very large production. The gear blanks, as they come from the dies, have holes in the center, and are slightly larger than the correct outside diameter. Fifteen or twenty blanks are inserted over a projecting end of the lathe spindle, and a nut is screwed on to hold them together. The driving belt is then shifted, and as the blanks revolve rapidly they are turned by means of a hand-operated cutter-bar.

This cutter-bar *A* is simply a tube containing a small cutting tool, which extends outward far enough to turn the blanks to the correct size when the bar is pushed along the supporting members *B*. As will be seen, the bar rests against vertical faces on these fixed supports, so that the cutter, which bears on an additional support *C* near its outer end, is always in the same position. After a stack of blanks has been turned, this cutter-bar is placed on the bench, so that it will not interfere with the removal of the finished blanks and the reloading of the spindles. As soon as a new stack of blanks is in place, the cutter-bar is again placed on its supports, and as it is pushed along parallel with the lathe spindle the blanks are rapidly turned to size.

Automatic Machines for Cutting Small Gears

Machines of the automatic or semi-automatic types have been widely used for cutting small gears in watch and clock factories, and by manufacturers of meters, recording instruments, and various other kinds of apparatus requiring gearing of the class mentioned. Methods of using some of the machines built by the Waltham Machine Works, Waltham, Mass., are described in the following: Fig. 5 shows a plan view of a semi-automatic machine for cutting spur gears up to 4 inches pitch diameter with diametral pitches of 16 and finer. This machine is so designed that the movements of the slides and the indexing are automatically controlled, and are continued until the machine stops after completing the last cut. The insertion or removal of the work, however, is done by hand, so that the machine is not fully automatic like some of the types referred to later. This machine is of the formed-cutter type.

Referring to Fig. 5, the cutter may be seen at *A*, and ordinarily a stack of gear blanks *B* is held on an arbor supported by two spindles, as shown more clearly by the detailed view, Fig. 6. The cutter-spindle is driven from shaft *C* (Fig. 5) by a silent chain transmission. A feeding movement is imparted to the work-slide by means of a cam which gives a quick return. The position of the work-slide relative to the cutter can be changed readily by means of a rack and pinion adjustment. During the return stroke, and

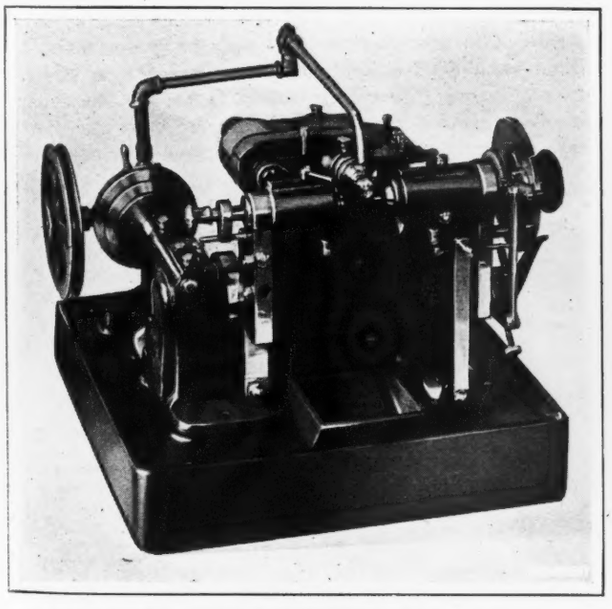


Fig. 7. Type of Gear-cutting Machine designed to meet Requirements of Watch Factories

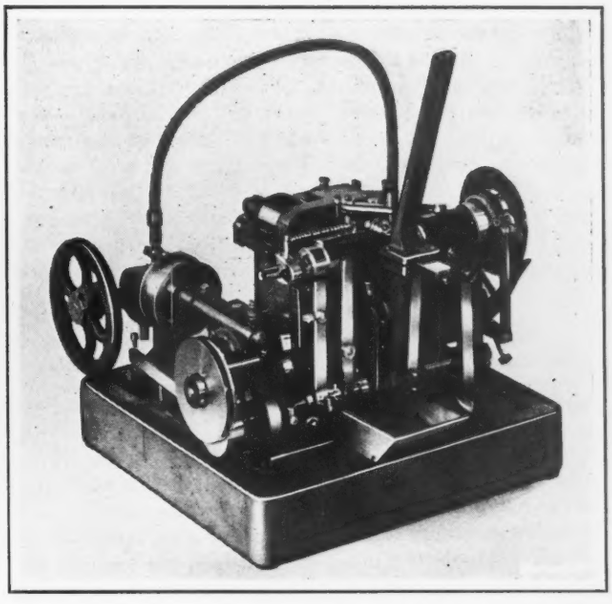


Fig. 8. Automatic Gear-cutting Machine equipped with Magazine Feeding Attachment

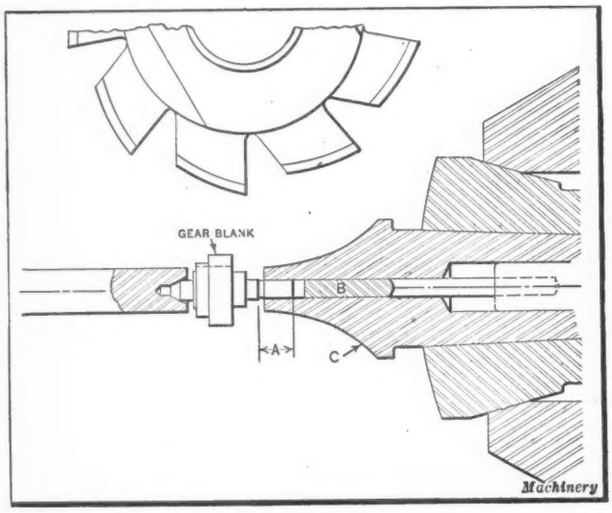


Fig. 9. Method of holding a Pinion Blank

while the work is being indexed the cutter-spindle slide is elevated automatically, and this slide is clamped automatically during the cutting stroke. Vertical adjustments of the cutter-slide for regulating the depth of cut are controlled by a handwheel graduated to thousandths of an inch.

The front bearing of the cutter-spindle is threaded on the outside, and is rotated for centering the cutter relative to the work. A hinged cover *D* on the work-slide completely encloses the cutter and work. The positive indexing movement is controlled by one revolution of a camshaft which is idle except when indexing. The index-plate may be seen at the left of the work-spindle in Fig. 6. While the index mechanism may be arranged for obtaining different divisions, it is considered advisible, for manufacturing purposes, to use one index-plate for each number of divisions required.

The sprockets for the chain drive to the cutter-spindle are of different diameters and are interchangeable, so that either one may be used as a driver to vary the cutting speed. Additional changes are obtained by means of the stepped cone pulley *E*, Fig. 5. Speeds of 300 and 375 revolutions per minute are used for steel work, and 1200 and 1500 revolutions per minute for brass. For cutting tool steel of average quality and temper, a feed of 4 inches per minute is about right. For soft steel, the feed should be increased to about 7 inches per minute, for bronze to 15 inches per minute, and for brass to 20 inches per minute. These speeds and feeds are based on the use of a high-speed steel cutter 1¼ inches in diameter.

Machine Equipped with Roughing and Finishing Cutters

The gear-cutting machine shown in Fig. 7 is one of a line designed to meet the requirements of watch factories, etc. This particular machine is arranged for cutting pinions. The cutter-spindle is equipped with three cutters, two for roughing and one for finishing. The finishing cutter is nearest the front bearing and in the most rigid position. The cutter-spindle is shifted automatically for locating each of the three cutters in the working position. This machine is intended particularly for cutting steel pinions of 48 diametral pitch or finer. A similar machine equipped with a magazine feeding attachment is illustrated in Fig. 8. This machine is, of course, fully automatic in its operation, the blanks being automatically brought into the cutting position by the magazine feeding attachment.

Machine having Seven Cutter-spindles

The machine shown in Fig. 10 is used for cutting the teeth on the escapement wheels of watches. It has seven cutter-spindles, and each one carries a cutter of a different shape. The indexing of the turret, which contains the seven spindles, is automatically controlled, so that all operations are continuous after the work is placed in position. The spindles have screw adjustments for varying both the depth of cut and the location longitudinally, as some of the cuts are in a central position and others off center.

Methods of Holding Small Gears for Cutting

The type of work-holding arbor illustrated in Fig. 6 is recommended for use in connection with the 4-inch machine shown by the plan view, Fig. 5. The arbor holds a stack of blanks between two flanges that are nearly as large as the root diameter of the gears to be cut, thus providing rigid support. Figs. 9, 11, 12, and 13 show various methods of holding pinions and gears on machines of the class shown in Figs. 7 and 8. These same methods, however, may be applied equally well on larger machines.

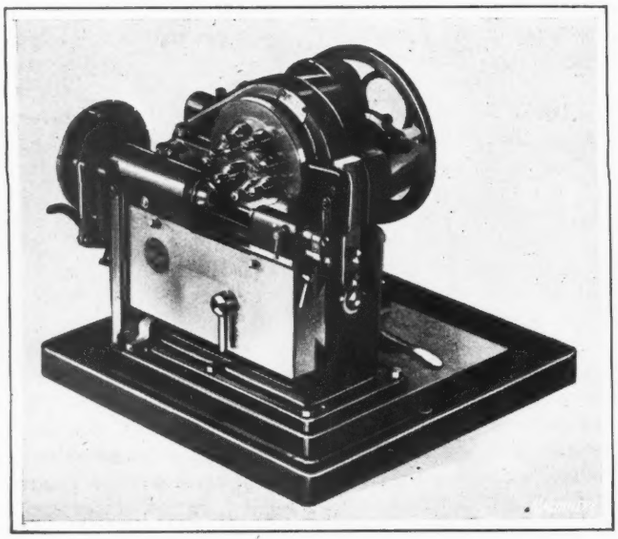


Fig. 10. Machine used for cutting Teeth of Watch Escapement Wheels

Fig. 9 shows how a pinion is held to insure cutting the teeth concentric with the pivots. The tapering section marked *A* is not a part of the finished pinion, but is merely used for holding the blank while the teeth are being cut. The opposite end is supported by a conical center in the tail-spindle. Machines operating on work of this class should be equipped with a magazine feeding mechanism. The rod *B*, within the head-center *C*, is used as an ejector.

Two methods of holding hollow pinions on automatic pinion-cutting machines having magazine feeding mechanisms are illustrated in Fig. 12. Referring to the upper view *A* in this illustration, the hollow pinion blank *b* is pushed on a slightly tapering center arbor *c* by the tail-center *d* in order to hold it firmly in place. The finished pinion is removed from the tapering arbor by the ejector-sleeve *e*, having a cross-pin that is engaged by ejector-rod *f*.

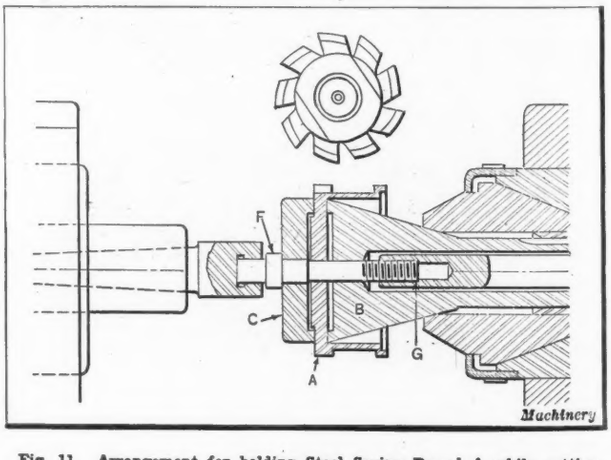


Fig. 11. Arrangement for holding Steel Spring Barrel A while cutting Gear Teeth

The lower diagram *B* shows a hollow pinion blank which is centered by the tailstock center and forced against a headstock center having corners that act as a driving dog for indexing the pinion blank. When the tail-spindle is withdrawn, the finished pinion comes against a stripper *g*, which strips or pushes the pinion off the center.

Holding a Steel Spring Barrel

In Fig. 11 is shown a method of holding a steel spring barrel while cutting the gear teeth on an automatic machine. The spring barrel *A* is held firmly against the end of chuck *B* by clamp *C*, which, in turn, is tightened by means of arbor *F* and draw-in screw *G*. The outer end of arbor *F* is supported by the tail-center.

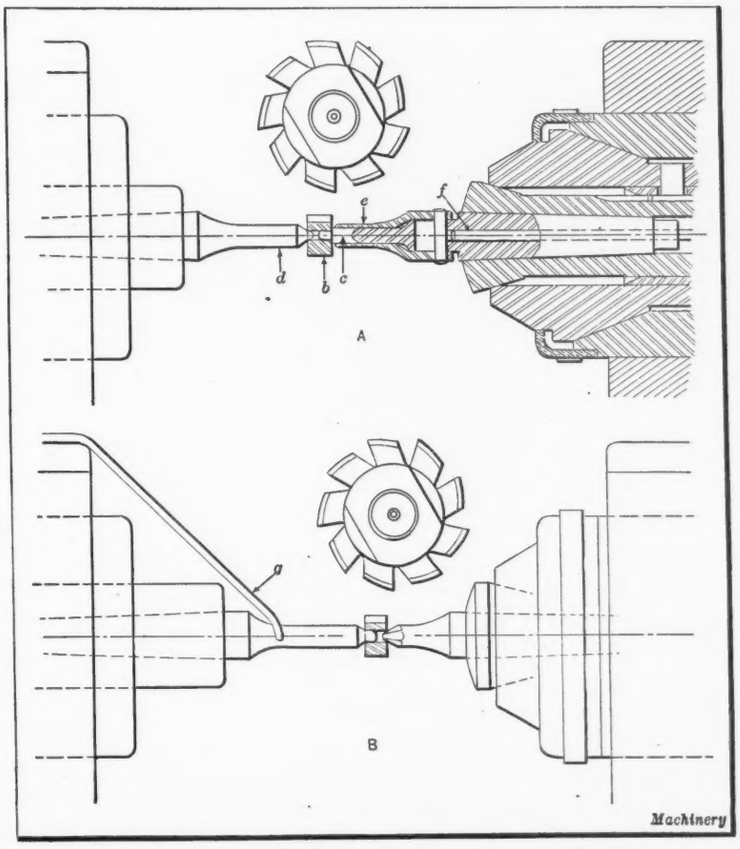


Fig. 12. Two Methods of holding Pinions having Center Holes

The upper diagram *A*, Fig. 13, shows a design of segment arbor such as is used for blanks with spokes. As the sectional view to the left shows, the segments of the arbor are between the spokes and hold the blanks by the inside of the rim. The stack of wheel blanks *a* is held between the nut *b* and the clamping nut *c*. Two arbors should be used to permit loading the blanks on one while the other is in the machine. When the arbor is to be loaded with blanks, clamping nut *c* is first turned back against the arbor shoulder, and nut *b* is removed. After sliding the blanks on the arbor, nut *b* is screwed against the shoulder at the slotted end of the arbor, and then nut *c* is tightened against the stack of blanks. These wheel blanks are without center holes, and a formed cutter is used to trim the tops of the teeth at the same time that the sides and root are finished. The gears are afterward held by the outside in order that the center hole may be located accurately relative to the teeth.

Holding Sector-shaped Blanks

Diagram *B* shows a method of holding sector-shaped blanks. The faceplate *f* has a pin or dog *d* engaging plate *e*. The blanks are clamped between this plate and the one on the opposite side, by nut *n*. The clamping stud and arbor locate the blanks (see end view), and the dog locates the holding device. The index-plate of the machine is set in relation to this locating dog. A duplicate work-holding device should be used to permit loading one while the machine is operating on work in the other.

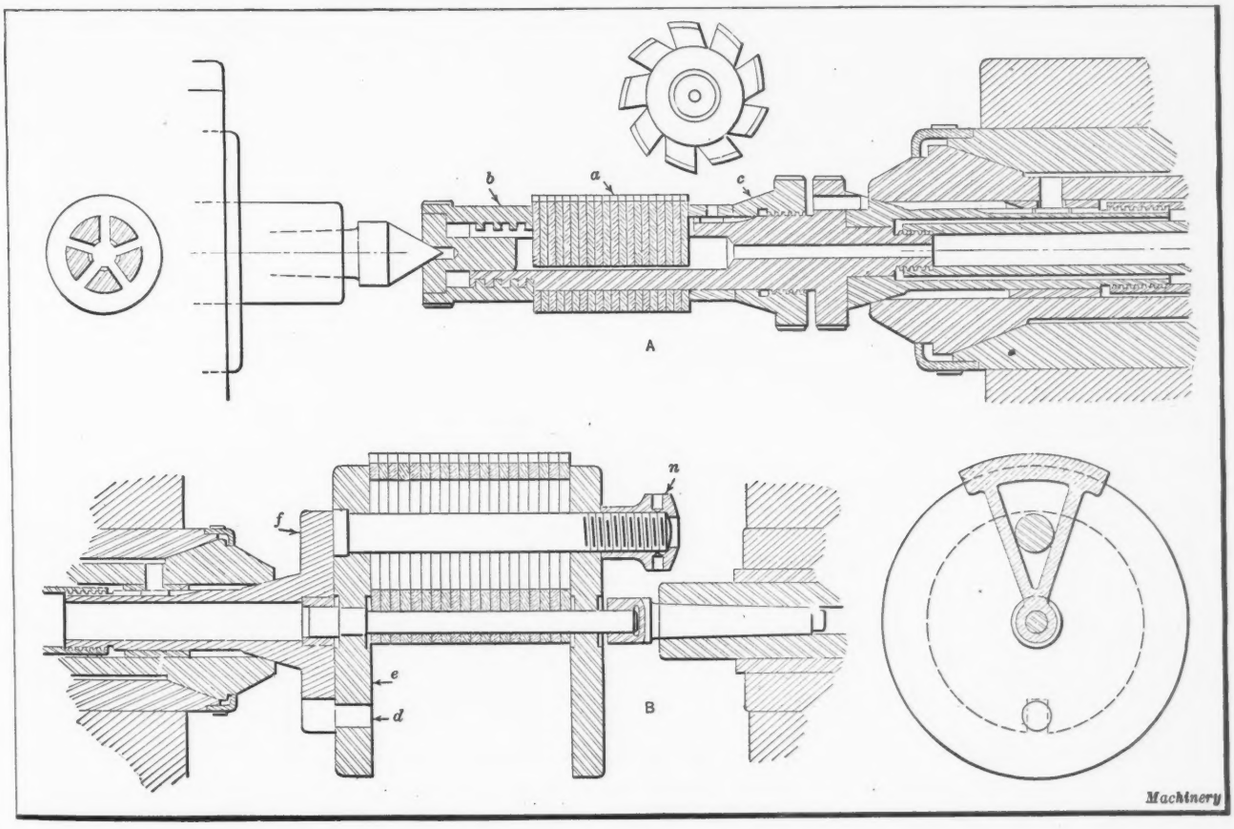
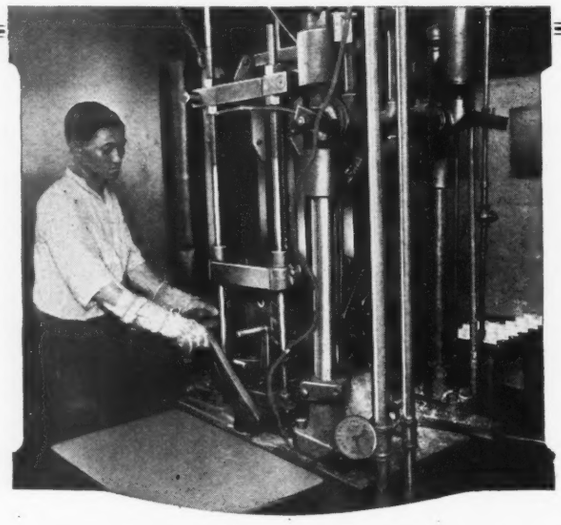


Fig. 13. (A) Segment Arbor for Blanks having Spokes; (B) Method of holding Segment Gears

Cores and Slides for Die-casting Dies

By CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



CORES and slides are the special means provided for casting holes, irregular sections, undercuts, etc., and the possibilities of producing a part by the die-casting process often depend on the ingenuity with which the coring of the casting is arranged. The cores are almost invariably drawn from the casting by a rock and pinion arrangement, as are also the slides, which are usually drawn from the sides. While it is necessary to provide a draft for the cores in nearly every case, when slides are used draft is not necessary for the surfaces of the casting formed by the slides.

The cores sometimes consist of loose pieces which are placed in the die before casting and removed by means of a hammer after the casting is made. The cores may be arranged in a variety of ways and these points are best covered by actual illustrations. Take the case of adding machine frames; aside from being exceptional products with regard to size, these castings also present problems in core arrangement. The ribbed interior of the castings is made from a single huge core, and the exterior from the parts of the die.

With the exception of only one part, that is, the rectangular vertical opening on the keyboard, all the sections are capable of being drawn from each other. Inasmuch as this vertical opening has rounded edges on the outside, it must be formed by a core drawn at right angles to the other cores. To accomplish this, the core used is separate and is ejected with the casting. It remains in the cast hole until subsequently removed. The core is then fitted back in the die for making the next cast.

Die with Several Slides and Two Long Cores

A very good example of die construction using slides and long cores for the central hole is that of the vacuum sweeper brush roll shown in Fig. 1. This part is made from aluminum and contains a central pulley and twenty-four lugs arranged helically so that a straight parting would be impossible on account of unavoidable under-cuts. These lugs are 15 degrees apart, and they are numbered both on the detail view, Fig. 1, and on the illustration of the die, Fig. 2, so that the construction of the die may be more readily understood.

The hole cores *A*, Fig. 2, are tapered from the center line of the pulley, and each is operated in the regular way by a rack and pinion. The length of these two cores makes it necessary to furnish an outboard support at each end of the die for the pinions, to allow for the necessarily long draw. The ejector die, a plan view of which is shown, consists of four slides arranged in pairs. The first pair part on the longitudinal center line of the casting and form lugs 4, 5, and 6 on one side, and 16, 17, and 18 on the other side. Sections of these two slides are shown at *C* and *E* in the lower left-hand corner of the illustration.

Lugs 1, 2, and 3 on one side, and 13, 14, and 15 on the other are formed by stationary die sections, as shown by the sectional view *D*. This two-piece construction facilitates machining, and is the only reason for the sectional design. These sections are of different widths so as to provide a stop or shoulder at the center line which will determine the position of the first-mentioned slides when closed. Lugs 22, 23, and 24 on the right-hand side of the pulley, and lugs 10, 11, and 12 are also produced by a pair of slides arranged to part as shown in the sectional view at the left. These mating slides are also arranged to fit against a stop or shoulder on the right-hand end section of the die which is stationary. This section is one piece and casts lugs 7, 8, and 9, it being unnecessary to use the two-piece construction to facilitate machining the impression. (See sectional view *B*.) The three opposite lugs, 19, 20, and 21 are similarly formed in the impressions in the cover die.

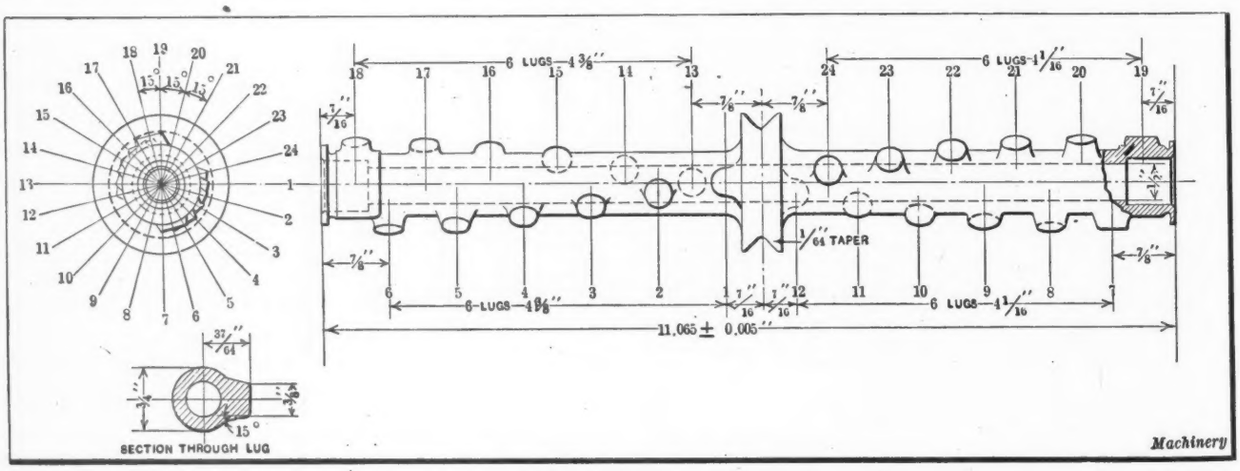


Fig. 1. Aluminum Die-cast Brush Roll for Vacuum Sweeper

The sectional views of the cover and ejector dies shown in their relative positions just before closing, indicate by number the relative position of the lugs. The slides are operated by pinions *F* and *G*. The point of greatest interest in this construction is the ingenuity used in the arrangement of slides so as to make it possible to stagger the parting line every third or fourth lug, thus avoiding under-cuts and making what might otherwise appear to be a most difficult problem, a simple and practical die-casting proposition.

Attention is called to the fact that the cover die is constructed to lock over the ejector die, locking members being provided on all four sides of the cover die. Another detail of importance, especially in large dies, is the location of the water line for cooling the dies. Both the cover and ejector dies are cooled. In this case the water line for the ejector die is shown at *H*. This pipe passes in and loops around under the central section of the casting impression and drains out on the other side. Corresponding water lines in the cover die are indicated at *I*.

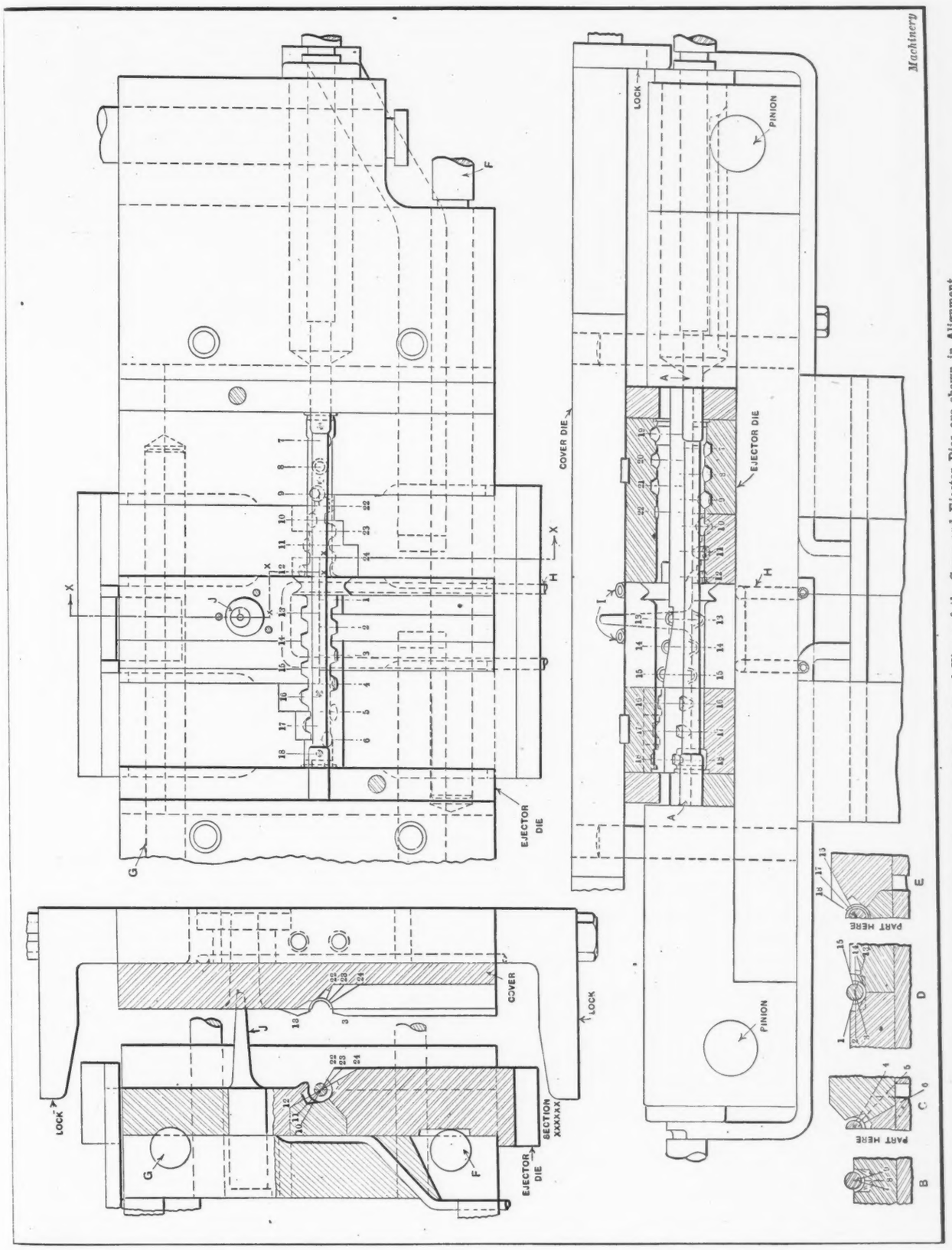


Fig. 2. Dies for casting Brush Roll. Sectional Views of the Cover and Ejector Dies are shown in Alignment

The sprue-cutter is located at *J*. The gate (not shown) is in the cover die, and consists of seven channels so located as to distribute the metal to the cavity proportionately. It will be noted that the sprue-cutter is offset relative to its body so that a larger radius is provided on the side toward the impression than on the other side. This is done to permit the metal to flow more freely in entering the gate. All dimensions on this casting are held to a tolerance of ± 0.005 inch or less, and the holes have a tolerance of + 0.001 and — 0.002 inch.

This is the last article in this series on die-casting machines and methods, and the design of die-casting dies.

* * *

METHOD FOR FINDING LEWIS FACTORS

By M. A. DURLAND, Assistant Professor of Machine Design, Kansas State Agricultural College

The most generally accepted method for finding the comparative strength of various gear tooth forms is by means of Lewis factors. In this method the weakest section of the tooth is found by passing a parabola through the point of intersection of the pressure line and the center line, the pressure line being drawn through the tip of the tooth. The point at which this parabola is tangent to the tooth curve locates the weakest section. The passing of a parabola through a given point tangent to a curve, however, is usually a tedious cut-and-try proposition.

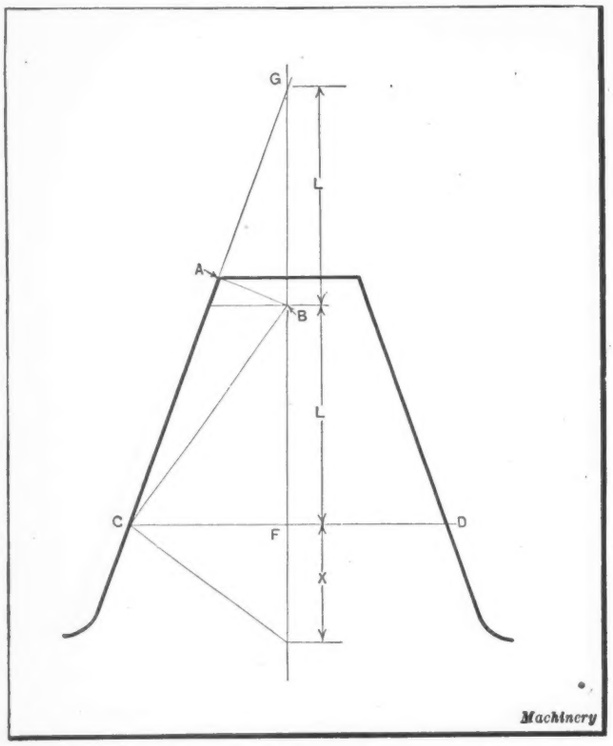


Fig. 1. Diagram illustrating Graphic Method of finding the Weakest Section of a Rack Tooth

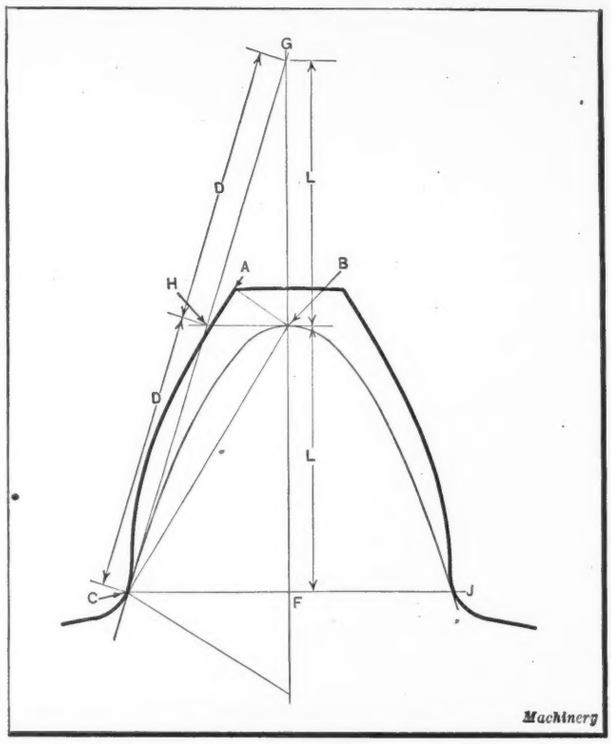


Fig. 2. Application of Method illustrated in Fig. 1 to Problem involving Spur Gear Teeth

In Lewis' original article he states: "In the rack tooth of 20 degrees obliquity this (the weakest section) is found at once by prolonging *CA*, Fig. 1, to its intersection *G* with the center line *FB* and laying off *BF* equal to *BG;* in other cases the weakest section may be found tentatively to a nice degree of accuracy in two or three trials." The first part of this statement is a mathematical fact, but the latter part does not sound particularly inviting.

To illustrate at least one opinion of the method described by Lewis, the writer will quote from an article appearing in October, 1922, MACHINERY, page 109. "The parabola scheme, which is well known, is a rather hit-and-miss method, and in order to obtain accurate results, it is necessary that the person using it have some experience in dealing with the strength of gear teeth. It is simple to apply, but the results are not so accurate as can be obtained by other methods." In the article referred to, an improved method is presented which perhaps gives as accurate results as any other method, but which, nevertheless, leaves much to be desired in the matter of convenience and time required.

Another method is presented here, which, although it may not be new, has never to the writer's knowledge been described in technical publications. It is believed to be a distinct improvement over each of the other methods referred to. At the point of tangency of the parabola and the tooth outline a straight line may be drawn tangent to both. It may be proved mathematically that this straight line will intersect the center line of the tooth at a point such that the distance from *G* to *B*, Fig. 2, is the same as from *F* to *B*. This procedure may be reversed for finding the point of tangency of the parabola and the tooth outline. The construction is as follows: Draw the pressure line *AB* through the point of the tooth. Erect a perpendicular to the center line of the tooth at *B*. Lay a scale tangent to the tooth curve near the root and crossing the center line. Now shift this scale, keeping it always tangent to the tooth curve, until the distance *GH* equals *CH*.

The point of tangency of the straightedge and the tooth curve is also the point of tangency of the parabola and the tooth curve, so that we now have located the weakest section, namely section *CJ*. The parabola shown in Fig. 2 is merely drawn for the sake of illustration, and of course would not be drawn in the actual solution, since the tangent point is all that is desired. This method is mathematically correct and much simpler than other methods in common use. The accuracy obtained is also equal if not superior to that obtained with any other method. It should be remembered that the results obtained with any method are entirely dependent on the accuracy of the gear tooth outline.

* * *

Trolley cars equipped with roller bearings are to be installed in St. Paul and Minneapolis, Minn. It is expected that there will be a saving of from 12 to 15 per cent in the power required for moving the cars, and that, in addition, the cars will be more easily controlled.

Babbitting Fixtures

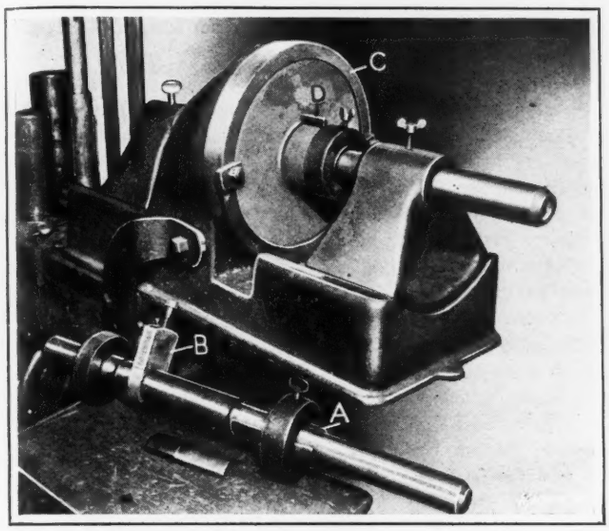


Fig. 1. Fixture used in babbitting Elevator Worm-shaft Bearing Thrust Box

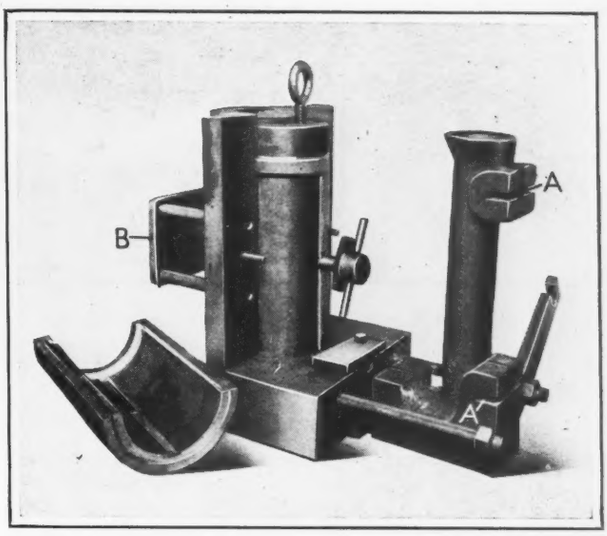


Fig. 2. Babbitting Fixture for Split Bearing Boxes for Elevator Drive Shaft

IN order to cast babbitt bearings in rough castings it is necessary to provide a means for holding the work securely while the mandrel for the hole is located in a true central position. The variety of casting design may often lead to the use of babbitting fixtures having special features. In this article a number of such fixtures are illustrated. All mandrels used are made over-size to allow for shrinkage. This may be from 0.005 to 0.010 inch on the diameter, depending on the size of the hole.

A sectional view of a thrust box for an elevator worm-shaft bearing is shown in Fig. 3, the babbitt lining being indicated in solid section. The fixture in readiness for pouring the babbitt, is shown in Fig. 1; an extra arbor with stop-collars used at each end of the bearing hole may be seen in front of the fixture. The mandrel has a key at one end for casting an oil-groove and is reduced in diameter at the forward end to accommodate the three-piece sectional sleeve *A*, which is fitted around this reduced diameter to cast the clearance space *A*, Fig. 3, for the oil seal. The one-inch wide slot *B* is cast by a separate piece *B*, Fig. 1, through which the mandrel passes. This loose piece is located in the proper position by a keyway fitting over a key on the mandrel.

The casting has a 2½-inch hole, a hub 4½ inches in diameter and 10 5/16 inches long, and a flange 11 inches in diameter. The casting is clamped by means of a ring *C* in the fixture, which is interchangeable for different diameters of castings. It is located with the ridge *D* in a vertical position, so that the pouring hole cored near this ridge will be on top. The mandrel is passed through the central hole after the casting has been clamped in place, and the stop-collars are located at the front and rear, but are not fastened at this time to the mandrel. The cored opening for slot *B*, Fig. 3, is located vertically. The work-holding part of this fixture has an opening at the rear through which the loose piece for casting this slot is dropped into the cored opening in the casting, where it is centered by the mandrel which is passed through it.

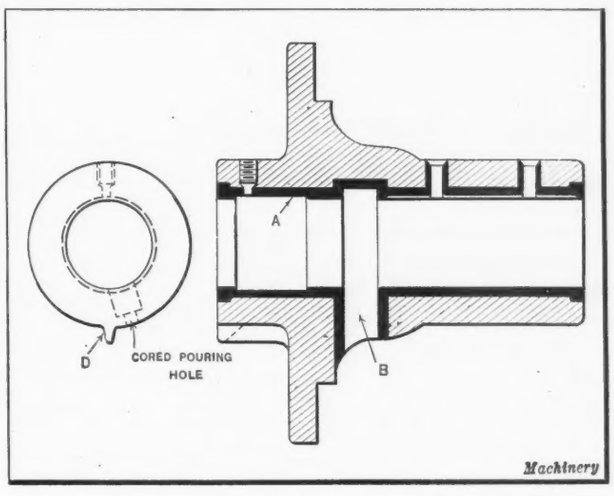


Fig. 3. Thrust Box babbitted in Fixture shown in Fig. 1

The three loose sectional pieces for the oil seal are then fitted around the mandrel, as the extra mandrel in Fig. 1 shows, and the front stop-collar passed over them against the hub of the casting and clamped; the rear stop-collar is also fastened at this time. The front and rear bearing brackets for supporting the extending ends of the mandrel are then located in position on the base of the fixture. These have a circular base for convenience in moving them laterally into alignment with the mandrel. Finally, the mandrel is fastened in these bearing brackets by means of thumb-screws, and the casting poured.

During the pouring, the operator watches the rise of the liquid babbitt around the loose piece for the oil slot (which is exposed to view), and when it overflows he stops pouring. At this time the cored pouring hole is also filled. To remove the work, the thumb-screws and clamps are loosened at the front and rear, the work with mandrel assembly removed, and the mandrel driven out by hitting it on the end. The split sleeve sections and the loose piece *B* then drop out.

The tapped hole and the two countersunk holes shown in Fig. 3 are machined after the bearing has been babbitted. Ridge *D* is chipped off on the dotted line to form a projection, from which any oil leaking from the end of the bearing may drip, instead of spreading all over the casting. There is always a slight amount of babbitt that escapes between the ends of the cast-

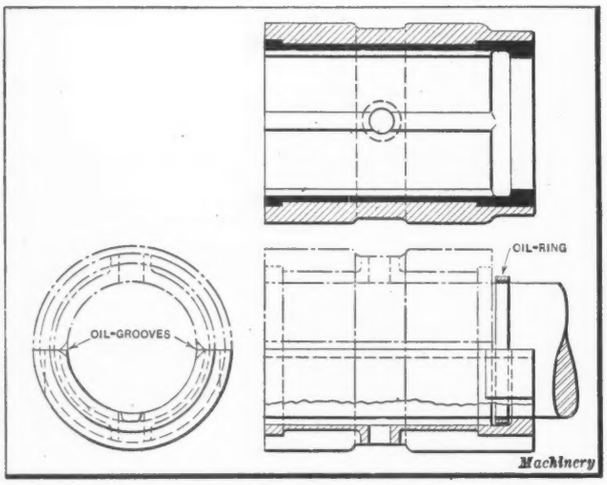


Fig. 4. Split Main Bearings babbitted in Fixture shown in Fig. 2

ing and the stop-collars, and this is subsequently squared off by facing on the ends.

Fixture for Split Bearing Boxes

The babbitting fixture shown in Fig. 2 is used for pouring split main bearing boxes used in elevator construction. The cylindrical part of this fixture has a flange at the bottom which fits into the base; this provides for using other mandrels, when bearings of different diameters are to be cast. The lower half-box has a longitudinal oil-channel leading to the oil-ring groove (see Fig. 4), and both castings have 45-degree beveled edges to form oil-grooves at the parting. These are all cast by means of the fixed mandrel.

In Fig. 2 the fixture is shown before it is fully assembled so as to expose the passage through which the metal enters, and the pouring spout. Best results are obtained in babbitting by pouring from the bottom, so that the metal will rise to the top. The pouring channel or gate is cut into the base of the fixture, and is covered by a strap. The pouring spout is split vertically and held together by clamps. These clamps are not shown in the illustration, but they swing in the slots *A*. The construction permits the pouring spout to be opened in case the sprue extends into it and prevents the work from being removed. The pouring spout is located so as to align with the gate in the fixture base, and fastened by means of a strap and two tie-rods.

The casting is located sidewise by two pins extending at each side, and is clamped by means of a pilot screw. The pilot screw also forms the ¾-inch oil-hole in each casting, and it carries a thick felt washer to seal the hole during pouring. A plate *B* carrying four ejector-pins is operated by a screw from the rear to remove the half-boxes after they are babbitted. The castings are faced on the ends to remove excess babbitt metal and finished at the joint with a file so as to assemble tightly.

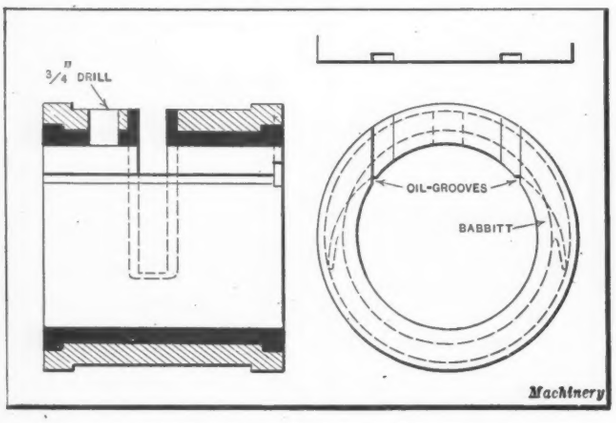


Fig. 5. Solid Bearing Box babbitted in Fixture shown in Fig. 6

Fig. 4 shows the channels for distributing the oil, as well as the assembly of the upper bearing, the position of which is indicated by dot-and-dash outline. The oil channel is ⅝ inch wide and ⅛ inch deep, and extends into the oil-ring groove in the lower member. The upper member of the box extends only to this oil-groove, so that the ring may hang on the shaft as shown. The babbitting of the upper member of the box is identical with that just described, and is performed in the same fixture with the necessary mandrel.

Babbitting Solid Main Bearing Boxes

A main bearing box for an electric elevator sheave shaft is illustrated in Fig. 5, and the fixture used in babbitting the lining in Fig. 6. This casting has two oil-grooves which are formed by projections on the mandrel, and a ¾-inch slot for the oil-ring which is formed by an inserted piece having a semicircular end. The ¾-inch hole in the box is drilled after babbitting, and the ends are faced as in previous examples.

In performing this operation, the cylindrical fixture used is set on a table under a drop-hammer. This set-up is shown in Fig. 6 with the hammer in its elevated position, guided by the side rails of the supporting frame. The hammer is held in this position by a latch, and after the babbitting has been completed it is released to knock the mandrel from the work. The casting is located over a circular plate and the mandrel lowered into it by means of a hoist to a depth determined by the pilot screw shown at the front of the fixture. The upper part of the fixture consists of two hinged members which are swung together to enclose the casting. These have a slot in which the previously mentioned loose piece is inserted and brought up against the mandrel, where it is held while strap *A* is slipped over posts on the swinging members. This securely clamps the entire arrangement.

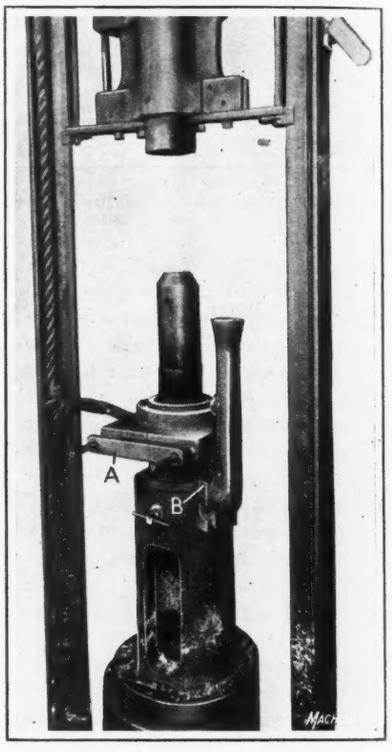


Fig. 6. Fixture for babbitting Bearing Boxes for Elevator Shaft

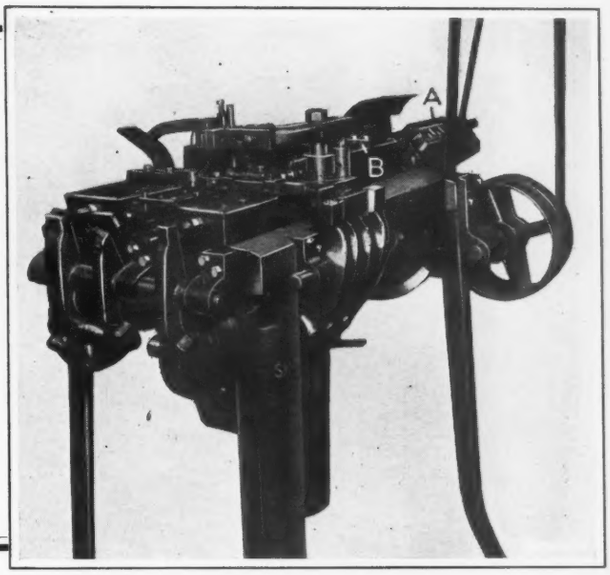
Piece *B* is then fastened to the side of the fixture. This piece contains the channel or gate through which the metal is admitted to the bearing. The pouring spout is then bolted to this piece, the arrangement being similar to that described in connection with Fig. 2. This pouring spout is also split longitudinally and clamped together when in use. After the bearing has been poured, it is necessary to remove the pouring spout before the hinged members can be swung to release the work. When this is done, the hammer is dropped to remove the mandrel. Various sizes of these bearings are all handled on this fixture by the use of suitable mandrels and loose pieces for the oil-ring slot.

The examples here cited are selected from the practice of the A. B. See Electric Elevator Co., Jersey City, N. J., where all bearing work is babbitted in fixtures of which these are representative.

Latch Needle Manufacture

A Description of the Methods Employed in Making Knitting Machine Needles, and the Special Equipment Employed

By FRED R. DANIELS



KNITTING machine latch needles are made in a great many designs, and the methods of manufacture are nearly as varied as the types of needles. The work is of a delicate nature, and the machines employed are ingenious in their construction and of special design. The names of the different parts of a latch needle of common design are indicated in Fig. 1. This illustration also shows a greatly enlarged view of the latch, and an enlarged sectional view of the needle blade.

The operations in the making of a needle of this type are as follows: (1) Cut off stock, bend butt, bend shank; (2) swage hook end; (3) flatten both sides (see sectional view); (4) mill slab; (5) set back point so that under side of needle will be straight its entire length, cut off pointed end to length, and center for latch rivet hole; (6) point; (7) mill slot for latch; (8) drill latch rivet hole, broach latch slot (under side); (9) tap for threaded latch rivet; (10) remove burrs from slot; (11) grind to remove burrs from edges; (12) assemble latch and rivet; (13) set down rivet; (14) grind ends of rivet flush with cheek; (15) impress ends of rivet; (16) bend hook; (17) grind end of latch that fits over needle hook; (18) harden and temper; (19) polish and straighten; and (20) inspect. Where two or more operations are given under one operation number, they are performed on a special machine at one time.

Forming the Butt and Shank

The needles are made from high-grade, cold-rolled steel wire, and are first bent to form the butt and the shank. For this work, a cam-operated machine (shown in the heading illustration) is employed, which closely resembles in operation the familiar wire-forming machines on the market. The wire is fed in from a reel at the rear, passed through a whirling wire straightener *A*, consisting of a series of staggered posts with grooves at the ends over which the wire is drawn, and thence into jaws by which it is gripped. The jaws are carried in a cam-operated slide *B*, the stroke of which may be adjusted to suit the length of needle. This slide carries the wire into the center of the machine, after which the slides that carry the bending dies advance in sequence to bend the butt.

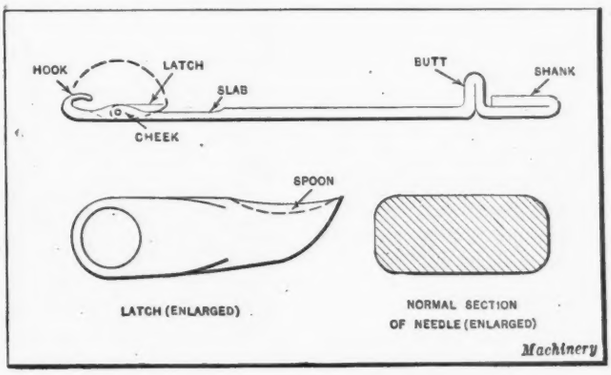


Fig. 1. Typical Design of Latch Needle with Enlarged Views of Latch and Needle Blade Section

If the needle has a bent shank (all needles do not), this is bent around the vertical king-post, which is then withdrawn and another horizontal slide advanced to close the end. The cycle is completed by cutting off the piece, which drops into a receptacle. It is next delivered to the swaging machine where the hook end is cold-swaged, after which it passes to a power press to have both sides of the needle flattened. (For details regarding the forming of wire, see August and September, 1922, MACHINERY; for cold-swaging data, see June and July, 1921, MACHINERY.)

Flattening and Slabbing Operations

Before referring to the flattening we may digress for a moment to refer to the slabbing operation which sometimes follows and sometimes precedes the flattening, according to the accepted practice in different shops. The slab is often short—not more than $\frac{3}{8}$ inch long—but in many designs of needles it extends for a considerable length. If it is long, it is invariably milled and the operation then follows the flattening; if it is short, it may be produced by indenting the round wire under a press, so that, in flattening, this indentation forms the slab and thus somewhat simplifies the manufacture. Obviously, there will be no rough edges produced by this method like those resulting from milling.

A Waterbury-Farrel power press, equipped with plain dies, and a special feeding arrangement, is used in flattening. This machine is illustrated in Fig. 2. This view shows the cam on the left-hand side and the mechanism that it actuates for operating the feeding device. Beneath the shelf *A* there is a sheet-metal slide which advances and recedes horizontally as the cam causes lever arm *B* to oscillate. The upper part of this arm is a spring-actuated extension, so that a post carried in the extension may travel horizontally in a slot in bracket *C* to move the slide.

Bearing against the under side of the slide, which is known as a "shovel," there is another sheet-metal shovel that is stationary and set at an angle, with its front edge bearing on the under side of the horizontal shovel. When the horizontal shovel is receded, its front edge coincides with the front edge of the shelf, and the angular shovel, which is bearing under tension against the horizontal

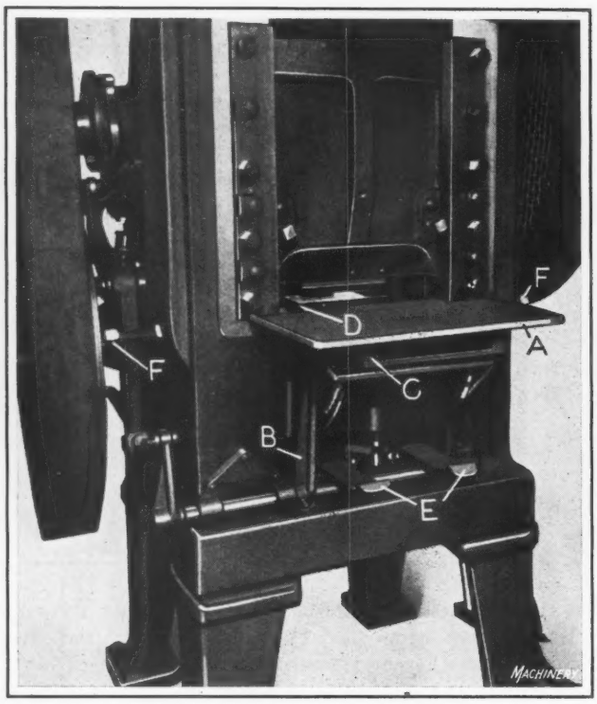


Fig. 2. Power Press Device used in flattening Needles, equipped with a Cam-operated Feeding Device

shovel, extends an inch or more toward the die, with its front edge above the top surface of the die, as shown at *D*.

The operator slides a needle to the edge of the shelf, where it rests flat on the angular shovel. Then the cam-operated shovel advances, sliding the needle along on the other shovel as it forces the end of the angular shovel down. The needle is thus fed along until it is deposited on the die, directly under the flattening punch. With the backward traverse of the shovel a third shovel advances from the rear, operated from the same cam that operates the front shovel. In the course of its return traverse, the front shovel permits the edge of the angular shovel to spring up sufficiently from the level of the die-block so that the rear shovel can push the flattening needle forward under it and into a receptacle supported on the spring arms *E*. This device enables a production of fifty-four needles per minute to be obtained.

The fact that the butt end of the needle is of heavier section than the latch end makes it necessary to use greater pressure at the butt end in flattening. This is accomplished by tilting the die at a slight angle to bring the punch and die closer together at the butt end. The change in the press, necessary to obtain this angular setting, consisted of machining the die-bed to a radius of 12 feet, and then machining the under side of the die to fit this radius. The adjusting screws *F* on both sides of the press are then used to move the die sidewise sufficiently, in setting it up, to obtain this angular setting. After the die has been rocked an amount determined largely by experiment, its position is secured by tightening the check-nuts on the adjusting screws.

If the slabs are milled, that operation follows the flattening, and is performed with a plain milling cutter. The work is stacked on edge in an indexing milling fixture, arranged to give continuous production. Both sides of the milling fixture are alike, so that a number of needles may be stacked on their back and milled while the other station is being loaded.

Machine for Setting Back the Tapered End

At this stage of manufacture the swaged end of the flattened needle is a symmetrical taper. The next operation consists of "setting back" this point so that one edge only will taper and the other will form the straight back edge. An automatic machine performs this operation, and at the same time makes the center for the rivet in the cheek (see Fig. 1), and severs the swaged end of the needle to establish a uniform length between it and the center of the rivet. This dimension is of the utmost importance, as is also the dimension from the rivet to the butt. This machine locates the needle correctly from the butt, so that the latter dimension is also accurately established. The machine is illustrated in Fig. 3.

The needles are stacked, butt up, in a chute *A* which is a portion of the table having a guide to accommodate the ends of the needles. They are fed along by a weight hung over a pulley and connected to a wire finger. The stack of needles is prevented from buckling under the pressure by means of flat springs which bear lightly on the needles and under which they are permitted to pass as they are fed toward the feeder *C*.

This feeder reciprocates, sliding a needle from the chute, between jaws, and into the operative position. One jaw is stationary and the other opens about ⅛ inch, by means of a cam-operated lever connected to a post on the movable jaw. Directly beneath this jaw there is a sheet-metal slide or shelf which allows the needle to be passed over it when the movable jaw is open. As soon as the needle reaches the operative position, the jaw closes and holds it during the functioning of the machine, while the feeder returns to advance another needle. At the completion of the operation, the movable jaw again opens, but previous to the movement of the jaw a spring has pulled the underneath shelf from under the jaw opening, permitting the needle to drop into a receptacle beneath.

This machine has all its movements actuated by cams. With the needle advanced to the operative position, a vertical plunger operated by lever *F* descends against the upturned edge, and holds the needle from moving under the pressure of setting back the point. This plunger contacts with the needle close to the beginning of the swaged taper, and remains in contact while a punch operated from lever *G* descends and sets back the point.

The centering tools for the rivet hole indent both sides of the cheek to a sufficient depth so that when the hole is drilled in a subsequent operation, it will be slightly countersunk to receive the rivet head. The two slides that carry the centering tools are shown at *H*. Finally, the cam-lever *I* advances another slide, which carries one of the cutting-off tools for shearing the ends of the needles to a uniform length; the other shearing tool is stationary but adjustable. The adjustments for setting the slides for centering and cutting off permit all sizes of needles to be handled on this type of machine. The feeder remains in the advanced posi-

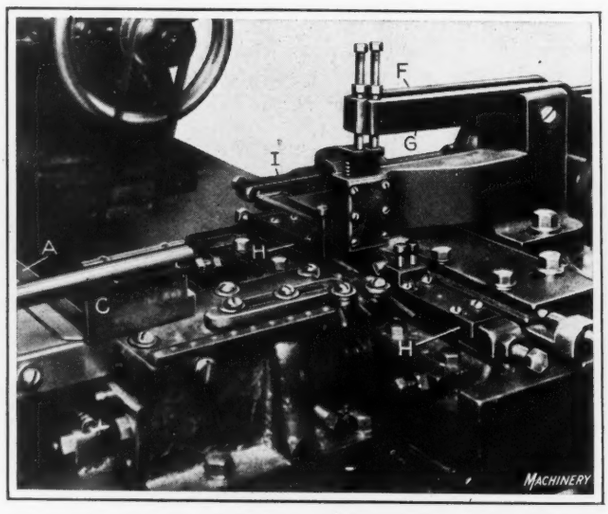


Fig. 3. Machine for setting Back the Taper End, cutting off, and centering Latch Needles

tion during this operation, and on its return the needle drops through the open jaws, as previously described. The severed end of the needle is next pointed, using a bench machine having a tool-head with four blades extending radially, similar to a box-tool.

Milling the Latch Slot

Milling the slot in which the latch is to be assembled is an operation upon the accuracy of which a great deal depends. Needles are made from wire ranging in size from No. 6 to 54 gage, the average size being No. 36, 0.029 inch in diameter. The approximate thickness of the saw is one-third the thickness of the needle, so that for a No. 54 gage needle, which is 0.020 inch thick, the slot would be 0.0065 inch wide. From this it will be seen that an error in central location of even 0.0005 inch would probably cause the work to be scrapped.

The slotting machine is equipped with the standard type of feeding arrangement, and a cam-controlled feed movement for the saw, with provision for varying the depth when desired. The position of the cutter-head may also be adjusted. The saws operate at a speed of 800 revolutions per minute, and the average production on this machine is 4000 needles per eight-hour day. Directly above the saw there is an oil-tube containing a swab, from which an occasional drop of cutting oil flows.

Drilling Rivet Hole and Broaching Slot

The next operations consist of drilling the hole for the rivet, and broaching the slot where it breaks through on the under side. In some methods of needle manufacture, the drilling is performed before cutting the slot, but both drilling and broaching have been combined to advantage in the machine shown in Fig. 4. In this method of manufacture advantage is taken of the passage of the broach to remove the burr from the inside of the slot where the hole breaks through.

This machine is similar in design to the point-setting and centering machine, Fig. 3. The drills operate from opposed spindles horizontally, and the broach *A* operates vertically, by means of the cam-lever *B*. The bellcrank feed-lever for one of the spindles is shown at *C*; it advances by cam action and returns by spring tension. The drills are flat drills, and for the average size needle are 0.016 inch in diameter.

If a threaded rivet is used (and this is generally recognized as an advantage over the straight pin in rivet), the holes are tapped after drilling on a horizontal bench machine with a clutch reversal. The needles are fed on the tap by hand. The tap is 1/64 inch diameter by 250 threads per inch.

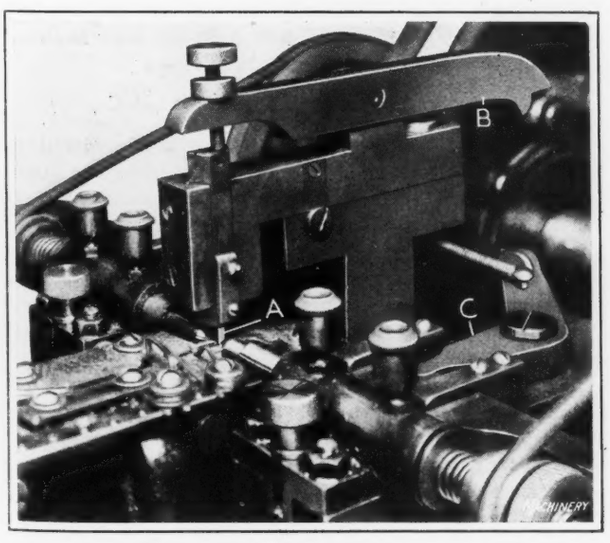


Fig. 4. Drilling Latch Rivet Holes and broaching Latch Slot on an Automatic Machine

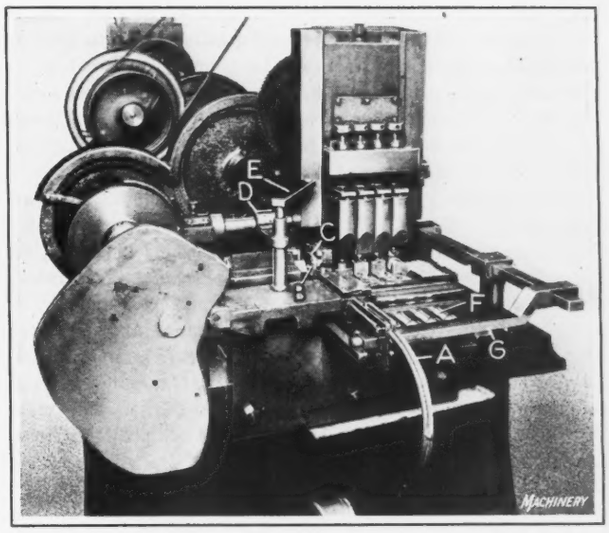


Fig. 5. Machine for making Needle Latches, cutting off Stock and performing All Operations

With the exception of smoothing up the needle by grinding the burrs from the outside of the broached slot, and removing the sharp edges on other parts by grinding, this completes the manufacture up to the time of assembling the latch. The burring of the broached slot and the edges are hand operations in which the needles are passed over the grinding wheel lightly.

Making and Assembling the Latches

Fig. 5 is a view of a latch machine which transforms wire from the reel into finished latches. The machine is unique in appearance and rapid in operation. The wire passes from the reel over the curved arm *A* and through jaws between which it is lightly gripped.

Five distinct operations are performed by this machine, the tools for four of which operate vertically, while the other operates horizontally. A horizontal tool is the first one to function, and this is called a "dapper" or "nooket" punch which forms the spoon in the latch. (See Fig. 1.) The end of this punch is shown at *B*, and directly in back of it there is another tool that holds the wire against the disk-like die *C*. This die has radial notches in which the wire is held. Then cam *D* operates a rod which pushes the chuck to the front. This is possible because the jaws do not hold the wire tightly. The movement of this rod leaves just enough wire projecting from the jaws to make the latch; in other words, it is a measuring device. This is necessary because the spoon is formed first in the end of the wire and permits no cutting off at this end, except trimming, after the latch has been finished.

A large irregularly shaped cam next advances the slide on which the chuck is located, successively to the four remaining stations. The first of these flattens the latch to fit the slot in the needle, the second pierces the rivet hole, the third trims the end, and the fourth cuts off the latch. At each advance of the slide, a hardened steel button on arm *E* is positioned under each of the adjustable stops at each station of the machine. This permits each vertical tool to operate without the others being moved, at each stroke of the vertical slide.

Micrometer adjustment is provided for these stops and also for the stops *F* that are used in setting the lower die-members. The long bar *G* extending across the front of the machine is used to draw back the chuck after each operation, preparatory to the next advance of the horizontal slide. This bar is operated by a cam at the rear of the machine, and springs are used to assist in returning the chuck when advanced to the next station.

At the last station two circular cutters sever the latch, which is deposited in a box at the right. The chuck is

then slid back by bar *G* and the slide returned to the starting position, when the cycle is repeated. Bar *G* next advances the chuck so that the short projecting end of the wire can be gripped in die *C*, as previously described, while the chuck is being pushed back to measure off the length of wire needed for another latch. The production is about 20,000 in a nine-hour day.

The assembling of the latches is done by hand, and girls are usually employed for this work. After some experience, the operators become quite dexterous in fitting the flattened end of the small latch into the slot, and screwing in the rivet. The needle, with latch and rivet assembled, is then ready to be riveted. A number of different types of riveting machines have been successfully employed, but possibly the most satisfactory machine is one employing two electric vibrators for delivering the blows. The movement is effected by a blade or spring which is actuated by the magnet of an induction coil, and its vibration produces a succession of rapid blows which can be suitably regulated. It is important that the rivet should not be swelled or bulged on the body at this time.



Fig. 6. Semi-automatic Machine which is employed for grinding the Ends of the Rivets Flush with the Cheek

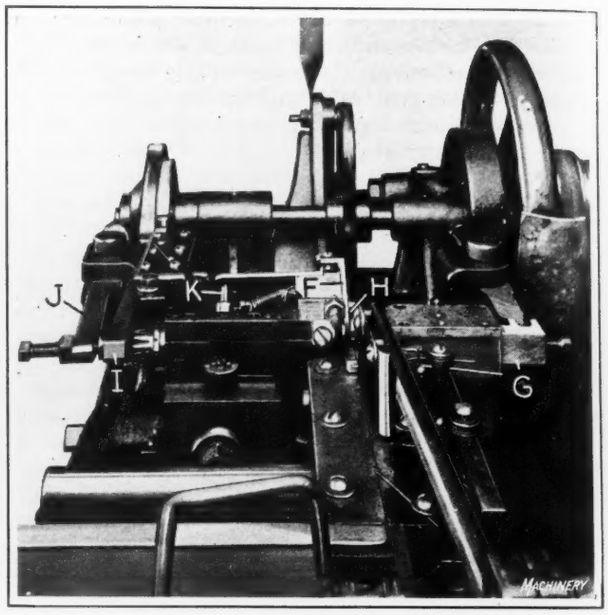


Fig. 7. Front View of Hook-bending Machine, showing Common Type of Feeding Mechanism for Needle Machinery

Grinding the Rivets Flush with the Cheek

A semi-automatic machine is used in grinding both ends of the rivet simultaneously. This machine is illustrated in Fig. 6, where a needle is shown held in the jaws at the loading station and two others are about to pass between the two grinding wheels by means of which the operation is performed. A revolving plate carries eight pairs of jaws. The movable member of these jaws is opened when one of the levers *A* is raised by means of a stationary cam beneath the plate. This occurs after the needles have passed between the two wheels, at which time a wire extending vertically dislodges the needle and gives it a spin so that it drops into a receptacle. The plate continues to revolve with the jaws open until the loading station is reached, when the operator inserts a needle and the movable jaw closes.

Another type of machine used for the same purpose employs spring jaws operating vertically instead of a cam-controlled chucking mechanism. These jaws hold the wire by spring tension, and each movable jaw is raised when it is tripped by a lever at the loading station. The spring jaw closes immediately and is opened after the needle has been ground, by the same arrangement.

Each grinding wheel is carried in a separate head and carefully guarded. Suitable provision is made for adjusting the height of these two heads so that they will be equidistant from the center of the needle, to suit work of different thicknesses. The distance between the faces of the wheels must also be accurately set, for which purpose a graduated sleeve with a conical end, located in back of the grinding wheel heads, is employed. Each wheel-head has a projecting lug at the rear, in which an adjusting screw is carried. These contact with the conical end of the graduated sleeve, so that by turning the knurled head of the sleeve both wheel-heads will be spread or brought together at the same time, the micrometer reading being used to determine the space between them. This permits a ready means of compensating for wear on the face of the grinding wheels.

A novel method of lubricating the wheels is employed. This consists of passing tubes into the center hole of each wheel, which is cut out to produce an annular channel in the babbitt, into which kerosene oil is delivered from the tank shown. The centrifugal force causes the kerosene to penetrate the wheel and work out to the periphery. This is an effective means of obviating a difficulty experienced in lubricating the wheels from the outside, when the oil is often precipitated into the operator's face; it also facilitates guarding the wheels.

Importance of Correctly Riveted Latch

It is important to note at this time the finer details involved in the assembling of the latch. It is not simply the setting down of a rivet, as ordinarily conceived of, because there must be not only a free movement of the latch but at the same time only a limited amount of side movement. A great deal of research work has been done to determine the exact size and type of rivet for each size joint, and there is still some difference of opinion regarding this.

After the rivet has been set down, an operation is performed which is known as "impressing" the ends of the rivet. The purpose of this is to bulge the rivet so as to increase its diameter within the latch about 0.004 inch, but not to such a degree that it will be tight in the latch hole. If the diameter of the rivet is, say, 0.015 inch, the hole in the latch should be 0.020 inch, leaving 0.0005 inch clearance all around after the rivet has been bulged 0.004 inch.

This is done to prevent the sides of the slot from contracting due to hardening and leaving the ends of the rivet projecting from the surfaces of the cheeks. This difficulty, of course, is more noticeable with plain rivets than with threaded rivets; in fact, the use of threaded rivets is favored principally for this reason.

With the threaded rivet, the plain hole in the latch has a bearing on the threaded central portion of the rivet which, of course, is theoretically incorrect. However, no ill effects have resulted from this condition, owing, no doubt, to the very fine thread on the rivets—250 per inch. The operation of impressing the ends of the rivets follows the grinding, and it is of great importance. It is performed by simply pressing the rivet from the ends under a uniform and predetermined pressure.

Bending the Hooks

An automatic hook-bending machine is shown from the front in Fig. 7 and from the right-hand side in Fig. 8. This machine is of the same type as the other cam-operated machines previously described, in which the needles are advanced by a feeder, held by jaws, and released so that they drop through when a slide is opened beneath the jaws.

With the work advanced to position in this manner, the roll-carrier *F* is oscillated to bend the hook around a horizontal post. The first movement of the machine is the advance of this post by slide *G*, which locates the post over the point of the needle. There is a grooved roll *H* in the carrier which, in its operative position, is slightly above the end of the needle. The carrier is oscillated on its forward movement by means of the cam-operated rack *I* and a pinion, and at the same time the carrier is pivoted to swing the roll down into contact with the needle. This is accomplished by a lever *J* operating from the side of the cam, which actuates a rod extending through the pinion. The rod has a beveled end that raises post *K*, thus pivoting the carrier.

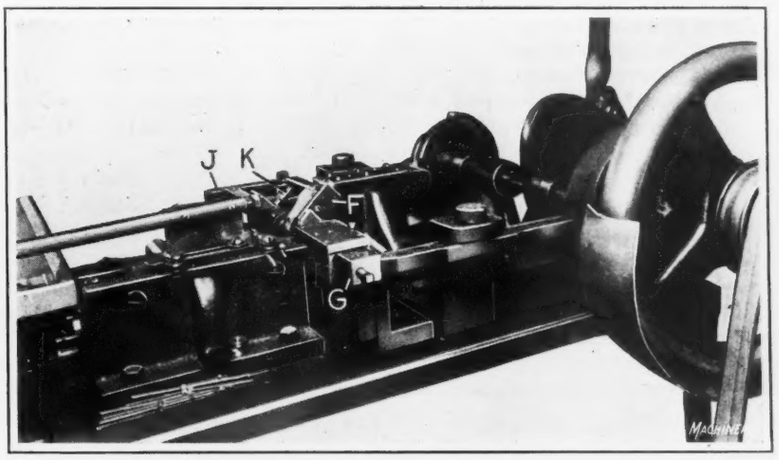


Fig. 8. Side View of Hook-bending Machine shown in Fig. 7

As the carrier is oscillated and the hook formed around the horizontal post, the cam-lever *J* is withdrawn, permitting a spring to raise the roll again before the backward oscillation occurs. The arrangement for pivoting the carrier provides the correct amount of tension required for bending the hook properly. An inspection of the needle in Fig. 1 will show that the end of the hook is not concentric with the center, and consequently pressure must be applied in bending, which will cause the roll to contact firmly with the hook, even at the extreme point.

Final Operations

The final operations in the manufacture of latch needles include grinding the latch on the end near where it engages the hook. This is a hand operation, and is usually performed by one stroke of the work against the grinding wheel. The needles are next hardened and quenched in oil, and then drawn to a spring temper. After tempering, they are polished by tumbling in sawdust, and then straightened. The straightening operation is done manually with a hammer and block, and requires considerable skill. The experienced straightener seems to sense where a blow delivered against the needle will accomplish the desired results. The needles are straightened about as fast as the operator can tap them with a hammer when laid on a block. The final operation is inspecting.

* * *

STANDARD STEEL FOUNDRY TRADE PRACTICES

At a recent meeting of the Electric Steel Founder's Research Group held in Pittsburg, Pa., the following standard trade practices were adopted:

1. Suitable pattern equipment for economical molding shall be furnished by the customer.

2. The foundry will not be responsible for correctness of pattern equipment, except when such equipment is made for the customer under the supervision of the foundry.

3. Repairs on pattern equipment shall be paid for by the customer, except when occasioned by carelessness on the part of the foundry.

4. Patterns must have distinctive colors to identify separately the core-prints, machined surfaces, and rough casting.

5. All patterns, core-boxes, and loose pieces must be properly numbered so that they can be easily identified.

6. All transportation charges on pattern equipment to and from the foundry shall be paid by the customer.

7. The foundry will not carry insurance on customers' pattern equipment.

8. Free replacement will be made of defective castings if reported and returned to the foundry within a reasonable time.

9. The foundry will not be responsible for any expense on defective castings incurred by the customer.

10. The customer will be charged with the cost of molds and cores discarded by the foundry due to change in patterns or core-boxes.

* * *

EXPORTS OF LEADING NATIONS

Notwithstanding the enormous volume of American manufactures, this country is not the leading nation as an exporter of industrial products. Great Britain is still first in the export trade in manufactures, according to E. M. Miller of the National Bank of Commerce, New York. In the iron and steel field, the United States exports only about 6 per cent of the total product, machinery excluded. Germany exported, in 1922, 30 per cent of all the iron and steel products of that country, and the United Kingdom exported as much as 58 per cent of the products of its blast furnaces and steel mills.

On the other hand, it must be remembered that no other nation has a home market like that of the United States, and for that reason it is but natural that this country should consume a much greater percentage of its own products than any other nation in the world. As a matter of fact, the home consumption in the United States is the most important market for our industrial products, and considered from a national point of view, export trade is necessary only to the extent that we may be able to import such raw materials and foods as are not available in the United States.

Tool-room Formulas for Locating Holes in Work with Angular Faces

By W. G. HOLMES

THE formulas presented in this article have been developed for the use of the toolmaker when his work requires the accurate location of a hole in an angular face. This problem is of frequent occurrence in the toolroom, and is often the cause of much disagreement as to the correct solution. The formulas presented cover all cases that are likely to come up in actual practice. For taking measurements from either side of the plug (see Fig. 1), and from surfaces that are located from 0 to 90 degrees with the horizontal, the following four cases must be considered:

1. Where the button is above the plug and the angle A of the working face is less than 45 degrees (see Fig. 1).
2. Where the button is above the plug and the angle A of the working face is more than 45 degrees (see Fig. 2).
3. Where the button is below the plug and the angle A of the working face is less than 45 degrees (see Fig. 3).
4. Where the button is below the plug and the angle A of the working face is more than 45 degrees (see Fig. 4).

Solution for Case 1

In Case 1, we have given the angular surface GG, Fig. 1, and a hole perpendicular to this surface. The angle the surface makes with the horizontal is less than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the surface GG. A button of radius r is placed above the plug, and in contact with both the plug and the angular surface. The following dimensions are known:

A = angle that surface GG makes with the horizontal (in this case less than 45 degrees);
r = radius of button; and
d = radius of plug.

It is desired to find:

E = vertical distance from top of button to horizontal line through point V;
F = vertical distance from bottom of button to horizontal line through point V;
C = horizontal distance from right-hand side of button to vertical line through point V; and
B = horizontal distance from left-hand side of button to vertical line through point V.

The solution is as follows: As HJ is the diagonal of a square, angle $Q = 45$ degrees.

Then

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$

and

$$T = 90 \text{ degrees} - (45 \text{ degrees} + A) = 45 \text{ degrees} - A$$

Now,

$$Z = HJ \sin T = 1.4142r \sin T$$
$$S = HJ \cos T = 1.4142r \cos T$$
$$P = d \sin A \qquad X = d \cos A$$
$$E = P + S + r$$

But by substitution

$$E = d \sin A + 1.4142r \cos T + r$$

Now

$$F = E - 2r = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \sin A - r$$

Also

$$C = X + Z + r$$

By substitution,

$$C = d \cos A + 1.4142r \sin T + r$$

Now B = the difference between $2r$ and C, so either $B + C = 2r$ or $B + 2r = C$. In this case it is evident that $B + C = 2r$, as the perpendicular line through point V passes through the circle representing the circumference of the button. It will be noted from the diagram that:

$$W - Z = N = K = Y = r \sin A$$
$$M = r \cos A - N = r \cos A - r \sin A$$
$$M = r (\cos A - \sin A)$$

From the preceding formulas it is possible to obtain any dimension that is likely to be required in checking or laying out work of the nature shown in Fig. 1.

Solution for Case 2

In Case 2, we have given an angular flat surface such as GG, Fig. 2, and a hole perpendicular to the given surface. The angle that the surface GG makes with the horizontal is

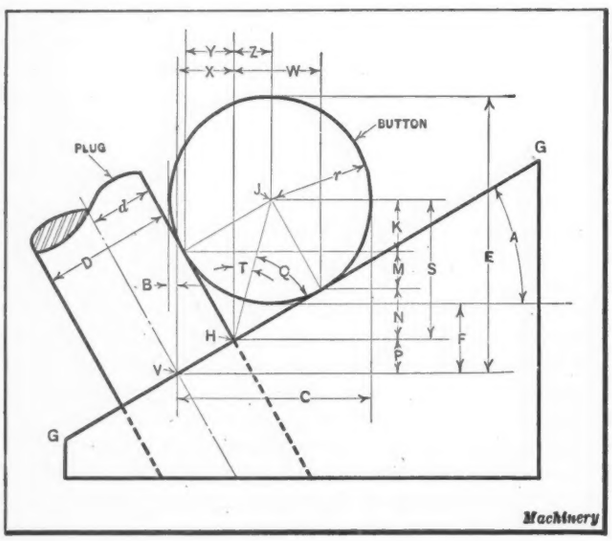


Fig. 1. Diagram used in determining the Location of a Hole in Angular Faced Work

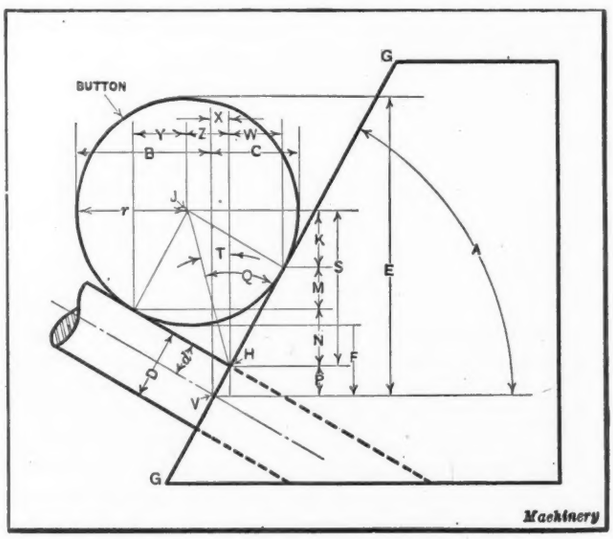


Fig. 2. Diagram used in Place of Fig. 1 when Angle A is Greater than 45 Degrees

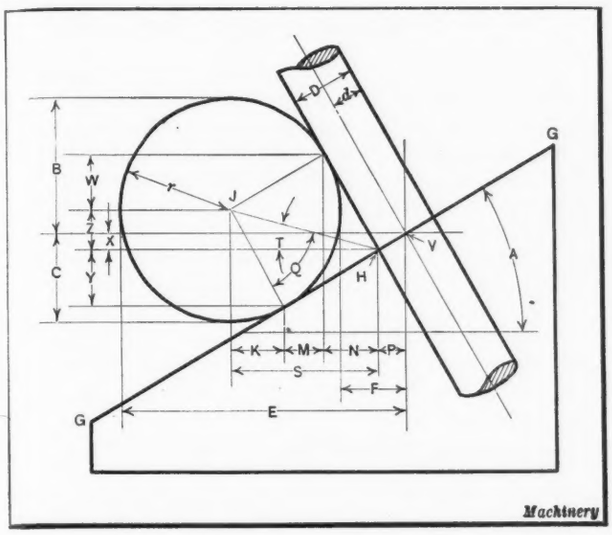


Fig. 3. Diagram showing Button placed below Plug to determine Location of Hole

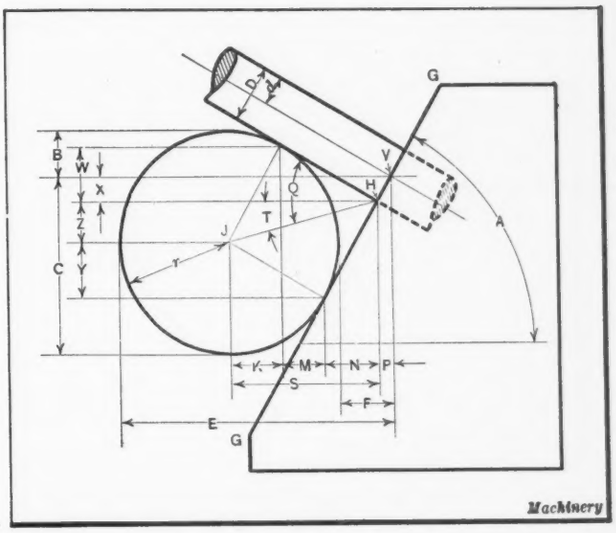


Fig. 4. Diagram used in Place of Fig. 3 when Angle A is Greater than 45 Degrees

greater than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the angular surface. A button of radius r is placed above the plug and in contact with both the plug and the surface GG. The following are the known dimensions:

A = angle that surface GG makes with the horizontal (in this case greater than 45 degrees);

r = radius of button;

d = radius of plug.

It is desired to find:

E = vertical distance from top of button to horizontal line through point V;

F = vertical distance from bottom of button to horizontal line through point V;

C = horizontal distance from right-hand side of button to vertical line through point V; and

B = horizontal distance from left-hand side of button to vertical line through point V.

As HJ is a diagonal of a square, it is evident that angle $Q = 45$ degrees. Then by trigonometry we have:

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$
$$T = A - 45 \text{ degrees}$$
$$Z = HJ \sin T = 1.4142r \sin T$$
$$S = HJ \cos T = 1.4142r \cos T$$
$$P = d \sin A \quad \text{and} \quad X = d \cos A$$

Then by addition we have,

$$E = P + S + r$$

By substitution,

$$E = d \sin A + 1.4142r \cos T + r$$

Now

$$F = E - 2r = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \sin A - r$$

And

$$C = r - Z + X$$

By substitution,

$$C = r - 1.4142r \sin T + d \cos A$$

Now B = the difference between the dimensions $2r$ and C, so either $B + C = 2r$ or $B + 2r = C$. It is evident in this case that $B + C = 2r$, as the perpendicular line through point V cuts the circle that represents the button. It will be seen from the diagram that:

$$W = Y = N = K = r \cos A$$
$$M = r \sin A - N = r \sin A - r \cos A$$

or

$$M = r (\sin A - \cos A)$$

Solution for Case 3

In Case 3, we have an angular surface GG and a hole perpendicular to this surface, as shown in Fig. 3. The angle that the surface GG makes with the horizontal in this case is less than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the angular surface. A button of radius r is placed below the plug and in contact with both the plug and the surface GG.

The following dimensions are known:

A = angle that surface GG makes with the horizontal (in this case less than 45 degrees);

r = radius of button; and

d = radius of plug.

With the values given, it is desired to find:

E = horizontal distance from left-hand side of button to vertical line through point V;

F = horizontal distance from right-hand side of button to vertical line through point V;

C = vertical distance from bottom of button to horizontal line through point V; and

B = vertical distance from top of button to horizontal line through point V.

Now as HJ is the diagonal of a square, angle $Q = 45$ degrees. Then by trigonometry we have:

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$
$$T = 90 \text{ degrees} - (45 \text{ degrees} + A) = 45 \text{ deg.} - A$$
$$Z = HJ \sin T = 1.4142r \sin T$$
$$S = HJ \cos T = 1.4142r \cos T$$
$$P = d \cos A \quad \text{and} \quad X = d \sin A$$

Now,

$$E = r + S + P$$

By substitution,

$$E = r + 1.4142r \cos T + d \cos A$$

Also

$$F = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \cos A - r$$

Also

$$C = r - Z + X$$

By substitution,

$$C = r - 1.4142r \sin T + d \sin A$$

Now B = the difference between $2r$ and C, so either $B + C = 2r$ or $B + 2r = C$, depending on whether or not the horizontal line through point V cuts the circumference of the circle representing the button. It will be seen that in this case $B + C = 2r$. Referring to the diagram, we have:

$$W = Y = N = K = r \sin A$$
$$M = r \cos A - N = r \cos A - r \sin A$$
$$M = r (\cos A - \sin A)$$

Solution for Case 4

In Case 4, we have an angular surface GG, Fig. 4, and a hole perpendicular to the given surface. The angle the sur-

face GG makes with the horizontal is more than 45 degrees. A plug of radius d is placed in the hole that is perpendicular to the angular surface. A button of radius r is placed beneath the plug and in contact with the plug and surface GG. The known dimensions are:

A = angle that surface GG makes with the horizontal (in this case greater than 45 degrees);

r = radius of button; and

d = radius of plug.

It is desired to find:

E = horizontal distance from left-hand side of button to vertical line through point V;

F = horizontal distance from right-hand side of button to vertical line through point V;

C = vertical distance from bottom of button to horizontal line through point V; and

B = vertical distance from top of button to horizontal line through point V.

Now as HJ is the diagonal of a square, angle $Q = 45$ degrees. Then by trigonometry we have:

$$HJ = r \text{ cosec } 45 \text{ degrees} = 1.4142r$$
$$T = A - 45 \text{ degrees}$$
$$Z = HJ \sin T = 1.4142r \sin T$$
$$S = HJ \cos T = 1.4142r \cos T$$
$$P = d \cos A \quad \text{and} \quad X = d \sin A$$

Now

$$E = r + S + P$$

By substitution,

$$E = r + 1.4142r \cos T + d \cos A$$

Also

$$F = S + P - r$$

By substitution,

$$F = 1.4142r \cos T + d \cos A - r$$

And

$$C = r + Z + X$$

By substitution,

$$C = r + 1.4142r \sin T + d \sin A$$

Now B = the difference between the dimensions $2r$ and C, so either $B + C = 2r$ or $2r + B = C$, depending on whether or not the horizontal line through V cuts the circumference of the circle representing the button. In this instance it is evident that $B + C = 2r$.

From the diagram we also have:

$$W = Y = N = K = r \cos A$$

and

$$M = r \sin A - K = r \sin A - r \cos A$$
$$M = r (\sin A - \cos A)$$

* * *

RESULTS OF STANDARDIZATION

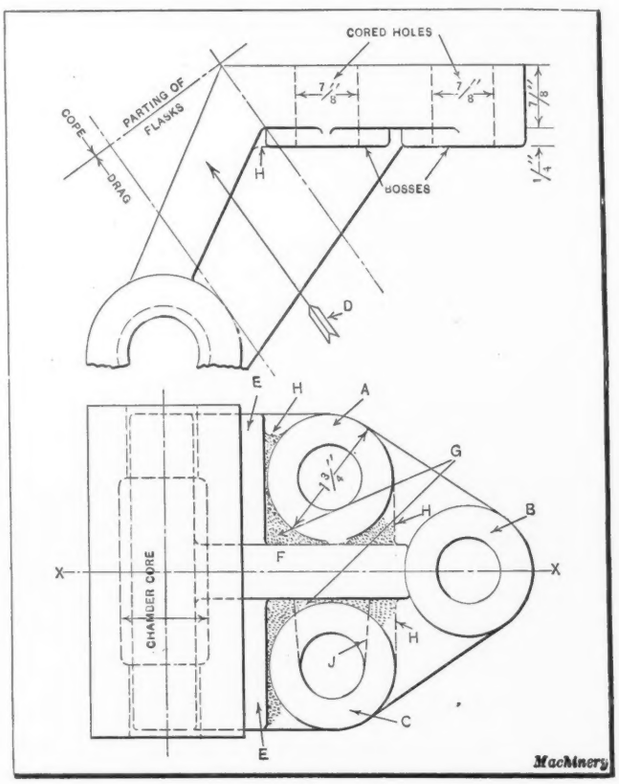
The great saving that can be made within a plant or a manufacturing organization by standardizing the parts used in the product has been well exemplified by the work accomplished in standardization and the elimination of needless costs by the General Motors Corporation. In an article in *Industrial Management*, D. G. Baird points out that this company in December, 1919, used 13,355 different parts in its products. This number was reduced to 2099 by simply standardizing similar parts that could be used for the different products of the company. The number of nuts used, for example, were reduced from 349 to 63, and even this number is said to be larger than is necessary. Duplication of effort causes more waste in the industries than is generally understood. Doubtless, before this standardization work was undertaken, it was believed that each one of the products of the General Motors Corporation had been reduced to its simplest form and that the manufacturing costs had been reduced to a minimum. In practically every shop and in every organization, there are opportunities for savings if a careful study is made with a view to eliminating all duplication of effort and all work that is not essential to the successful conduct of the business.

A MOLDING PROBLEM

By M. E. DUGGAN

Recently, while on a trip to the foundry, the writer noticed that one of the molders was having considerable difficulty in making a satisfactory mold from a bracket pattern. The job should have been a simple one for both the patternmaker and the molder. However, it had been made difficult, because the bracket had been designed with three bosses, as shown at A, B, and C. These bosses were unnecessary, and the bracket would have served its purpose just as satisfactorily if they had been omitted. Cored holes had also been specified, which further complicated the work. As only two castings were required, time would have been gained by drilling the holes instead of having them cored.

The direction in which the pattern was to be drawn from the drag flask is indicated by the arrow at D. The patterns for the three bosses were loosely pinned to the main pattern,



Bracket Pattern that presented Difficulties in Molding

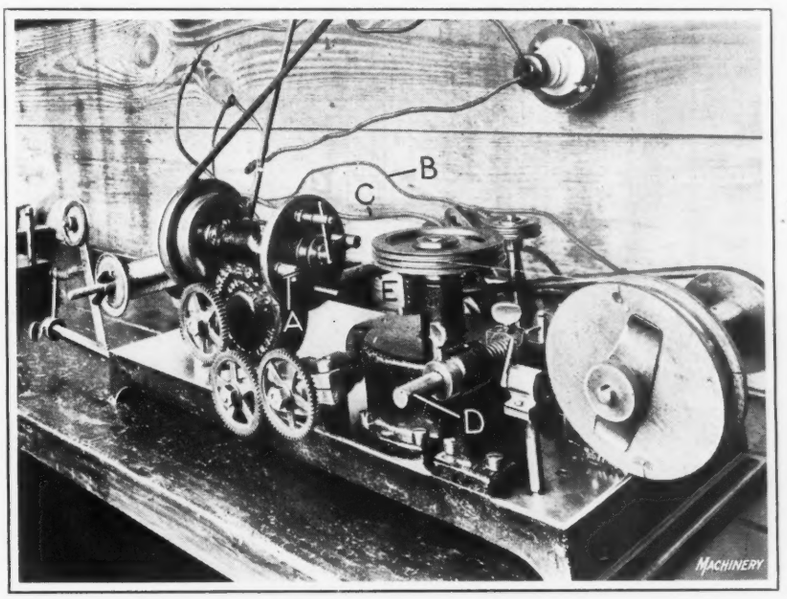
and the core-prints for the ⅞-inch cored bolt-holes were fastened to these loose pieces. It was impossible to produce a satisfactory casting from this pattern, because the small spaces between the ribs E and F and the bosses A and C formed sand pockets at G. The molding sand would not stand up in the mold at these points, much less withstand the washing effect of the molten metal.

By changing the pattern as described in the following, a satisfactory casting was produced. First the bosses or pads A and C were changed in shape, as indicated by the dotted lines at H, so that the sand pockets at G were eliminated. These pads or bosses were then fastened to the pattern, which was split along the center of rib F on line X–X. Tail core-prints of the shape indicated by the dotted lines at J were provided for the ⅞-inch cores. By changing the pattern in this manner, it could be molded half in the drag and half in the cope flask. Stock cores were used for the ⅞-inch cored holes, and the cavities left by the tail-prints were filled in. While a satisfactory mold was produced from a pattern constructed in this manner, it would have been much better and cheaper if the bosses or pads had been omitted from the design; also time would have been gained by drilling the holes instead of coring them.

INCANDESCENT LAMP MACHINERY

Developments in incandescent electric lamp manufacture have been quite extensive during recent years. The variety of styles of lamps having the filaments arranged differently has resulted in the evolution of a large number of automatic machines, some of which are of more than ordinary interest. In the lamp known as type B, the filament is zigzag and suspended from radial anchor wires at the top and bottom. This is the most common type lamp in present-day use. The filament used in this lamp is a plain tungsten wire, the manufacture of which was described in an article published in December, 1916, MACHINERY. The present article does not deal with the manufacture of incandescent lamps, except in so far as may be necessary in describing some of the more ingenious machines which have supplanted devices and methods formerly used, and which have been developed for the more modern types of lamps.

In the automobile lamp and what is known as the miniature lamp, both of which have globular bulbs, as well as in the type C lamp, the filament is a coil of very fine wire, closely wound. Some sizes of wire are as small as 0.0005 inch in diameter, the number of turns per inch running up to 850 with the inside diameter of the coil as small as 0.004 inch. The filament in the C lamp is attached to short anchor wires radiating from the center stem, as in the type B lamp, but it is arranged in a single horizontal plane near the large end, and not strung between anchor wires at both ends. There may be four or more of these anchor wires, and where they hook on the filament there must be a gap in the coil. The two ends of the coil filament are then electrically welded or clamped to the two lead wires that pass through the glass flare or bell-mouthed tube at the base of the lamp.



Machine for winding Coils of Filament for Incandescent Lamps

The machine illustrated in this article is made by Charles Eisler, Newark, N. J., and it is used for winding the filament either in a continuous coil or with intermittent gaps. The machine is automatic in operation, and thus it is possible for one operator to easily attend to five or six machines. Suitable speed changes may be made to obtain from 30 to 850 turns per inch and to provide for handling wire suitable for any size lamps from 10 to 1000 watts. The filament wire weighs from 0.90 to 270 milligrams per 200-millimeter length, which, converted into English standards, is from 1/31,500 to 1/105 ounce for 7⅞ inches of length. Expressed in inch measurements, the filament diameter is from 0.0035 to 0.0118 inch. The speed of the machine ranges from 500 to 4000 revolutions per minute according to the diameter of the filament being coiled. It is sometimes necessary to heat the filament electrically as it is being coiled, but this depends on the physical condition of the wire.

The coil is wound on a wire core, the diameter of which is from 0.004 to 0.035 inch, according to the requirements. This core wire is wound from a spool at the left-hand end of the machine, back over a V-pulley on a spring arm, and thence through a straightener directly in back of the driving pulley (not shown in the illustration). The core wire extends through the spindle, then through the spool attached to the faceplate on which the filament wire is carried, and around two grooved pulleys or drums, which provide tension for the core wire. It is wrapped twice around the drums, in the grooves, and then on a wooden spool or sheave at the right-hand end of the machine.

The larger of the two grooved drums is driven through change-gears, from the spindle of the machine, by worm-gearing inside a cover attached to the base of the machine. The filament from the spool on the faceplate passes over a V-pulley *A* and down behind a finger that guides it as the faceplate whirls it around. The tension on the core wire is what determines the uniformity of the spring windings. The flat brass spring between the sheave on which the coil is wound and the knurled nut that holds it to its shaft must be stiff enough to prevent the sheave from slipping and the core wire from slackening.

For continuous coils, this is all there is to the operation of the machine, except the heating of the wire, which is done by electric resistance, taking the current from a step-down transformer, one terminal of which is attached by wire *B* to the base of the machine as a ground, and the other by wire *C* to the post on which the smaller grooved drum rotates. The hub of the larger drum is insulated from the post on which it turns by a fiber bushing; and the nose of the spindle is similarly insulated. The (filament) tungsten wire is heated to a dark cherry red, discernible in daylight, at the portion extending from the faceplate where the winding occurs, and thus it becomes sufficiently pliable to be wound readily.

In winding coils intermittently, gaps are formed at predetermined distances between the closely wound coils. This is accomplished by momentarily turning the large grooved drum ahead quickly the correct amount, in order to increase the rate of travel of the core wire. The provision for accomplishing this movement makes it possible to revolve independently the vertical shaft for the larger grooved pulley, by means of a friction clutch arrangement within the worm-gear cover. Shaft *D* carries a shoe at its rear end that rides over a cam and causes the shaft to be pushed to the front against spring tension. This shaft carries a finger that engages the friction disk used to transmit motion from the worm-wheel to the drum shaft, so that when shaft *D* is pushed forward it rotates the drum shaft in advance of the speed of the worm-wheel. Collars on the shaft permit suitable adjustment for advancing the drum more or less, according to the length of gap required.

The camshaft extends at right angles to shaft *D*, and is driven by worm-gearing from a shaft in line with the worm-shaft for the drum. This second worm-shaft is driven, in turn, by a train of change-gears, similar to those shown at the front of the machine, but located at the rear. The driver of both gear trains is on the same shaft *E*, and this shaft is driven by worm-gearing from the spindle of the machine.

The sheave on which the coiled filament is wound is driven from a V-pulley on the worm-shaft by a round belt,

which slips on the sheave shaft pulley during the time that the wire is being coiled, keeping it taut; the belt revolves the sheave as soon as the tension on the core wire is momentarily released by the finger on shaft *D*, as previously mentioned. As the speed of the machine spindle is increased for the smaller sizes of wire, it is, of course, necessary to increase the speed of the cam, which can readily be done by means of the change-gears at the rear of the machine. The normal speed of the drums around which the core wire is wrapped is very slow, and is increased with the size of the filament and the speed of the spindle (turns per inch) by selecting the proper change-gears.

Before the filament coil can be used, it is necessary to remove the core wire by using acid solutions. For steel and iron core wires, sulphuric acid and water are used in equal proportions; and for brass wire, a solution of nitric acid and water, mixed in equal proportions, is employed.

* * *

BUSINESS COURTESY

In the reception room of a machinery plant in Ohio, the management has placed the following announcement, addressed to salesmen visiting the plant: "Welcome salesmen. The manager of this business was for several years a traveling man. If you are obliged to wait more than ten minutes, ask our telephone operator to connect you with the manager's office." The industrial enterprises that make it a business to accord to traveling salesmen the same courtesy that is bestowed upon their customers have more boosters for their business than they are aware of.

* * *

In a recent address, Secretary Hoover called attention to the fact that the railroads of the country have improved their efficiency along with the industries, even if not at as rapid a rate. In the last ten years freight movements have been increased by 15 per cent, with an increase of only 3 per cent in personnel. Furthermore, the management shows great faith and courage in undertaking a large program of expansion in spite of the handicaps under which the railroads have been laboring in recent years.

BLANKING, DRAWING AND PIERCING DIE

By I. BERNARD BLACK

A sectional view of a sub-press die of the two-pillar type employed in a watch factory for blanking, forming and piercing the barrel drum of a watch is shown in Fig. 1. At the left in Fig. 2 is shown a sectional and plan view of the barrel drum. The diameter of the blank before being drawn or cupped is 0.825 inch. The stock used is Bessemer steel, 7/8 inch wide by 0.016 inch thick. Before the die shown in Fig. 1 was designed for this work, it was the practice to blank and draw the piece and then pierce and size it in a separate operation. Both of these operations were performed in sub-press dies of the cylindrical type; thus two operations were required to do the work accomplished in one operation by the new die.

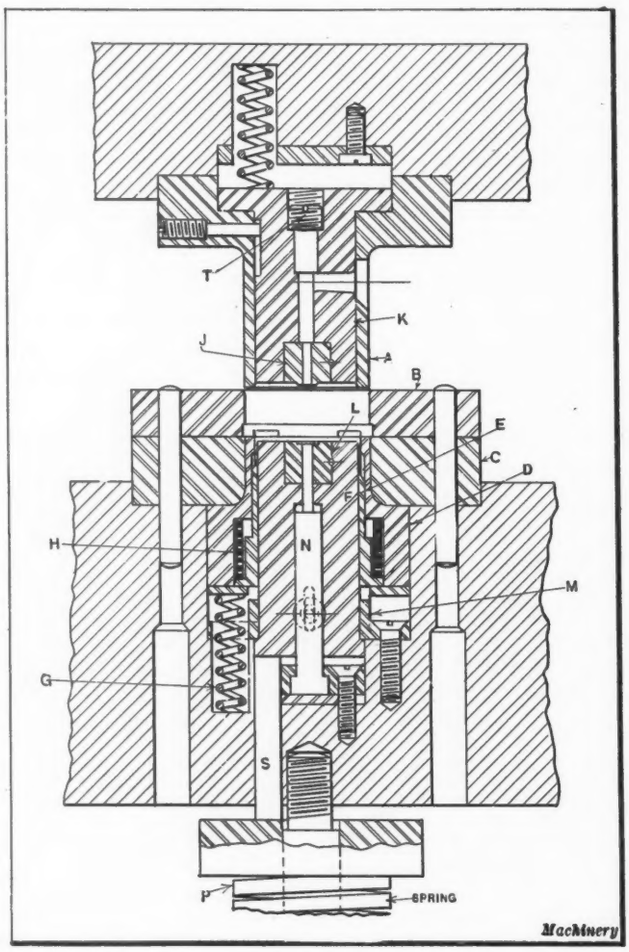


Fig. 1. Blanking, Drawing, and Piercing Die

The sectional view at the right in Fig. 2 shows the blanked, formed, and pierced barrel drum *W* in the position it occupies when the ram of the press has reached the end of its downward stroke. The construction of the punch and die, however, is more fully illustrated in Fig. 1. On the downward stroke of the ram, punch *A* passes through stripper *B*, and, entering die *C*, blanks the piece. Part *D* is forced downward by punch *A* as the latter turns down the outer edge of the blank. Parts *E* and *F* recede with part *D* due to the pressure of punch *A*, which acts against the pressure exerted by springs *G* and *H*. When the end of the downward stroke is reached, part *E*, having come in contact with part *M*, will have upset the flange, thus producing a square edge at the bottom. Piercing punch *N* will have entered piercing die *J*, and part *K* will have receded the required distance in punch *A*. At the right in Fig. 2 is shown a detail view of the most important members of the punch and die.

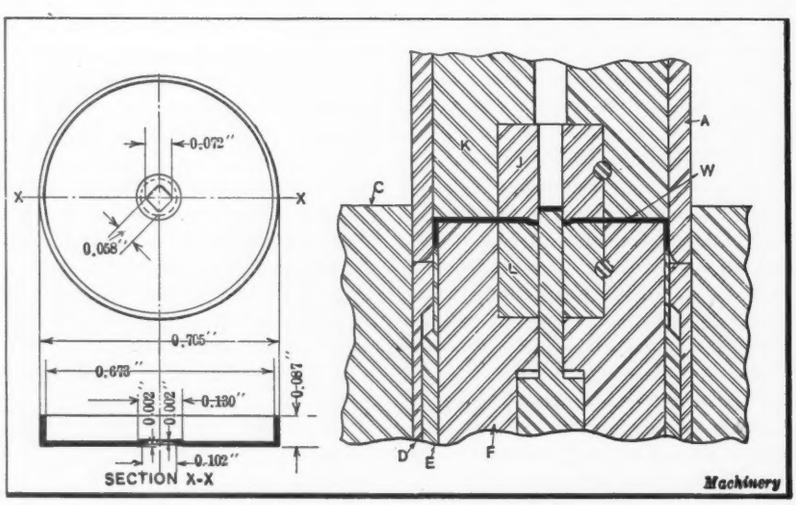


Fig. 2. Enlarged View of Work and Punch and Die Members

On the upward stroke of the press, the finished piece is pushed out of the die by the action of the heavy sub-press spring *P* and the springs *H* and *G*, which act against parts *D* and *E*. It will be noted that spring *P* exerts pressure on the die member *F* through pins *S*. In order to prevent interference of the work with the top of

the stripper, the latter member is cut away, as shown at *X*, Fig. 3. The problem of ejecting the work was solved by the use of four spring-actuated pins, one of which is shown at *Y*. These pins are designed to raise the stock just enough to permit it to contact with the center of the rim of the finished piece at *Z*. The stock, when fed in for the succeeding stroke of the press, serves to push the finished piece out of the die. It will be noted that although the design of the punch and die is rather complex, the parts are all cylindrical in shape, which greatly facilitates machining.

A novel feature of the die is the method employed for ejecting the piercings produced by punch *N*, Fig. 1. From this illustration it will be clear that the piercings will be forced upward through die *J* and will eventually fall out through a slot cut through parts *A* and *K*. A container is provided on the press to receive these piercings as they fall through the slot. The set-screw *T* provides a means of knocking or forcing out part *J*, should it be necessary to replace this member. An air vent through screw *T* leading to the slots through *A* and *K* obviates the forming of an air cushion, which would prevent the die from operating satisfactorily. Parts *A* and *K* are prevented from getting out of alignment by means of a pin and keyway as shown. Parts *J* and *L* are pinned to prevent them from turning in their holding members.

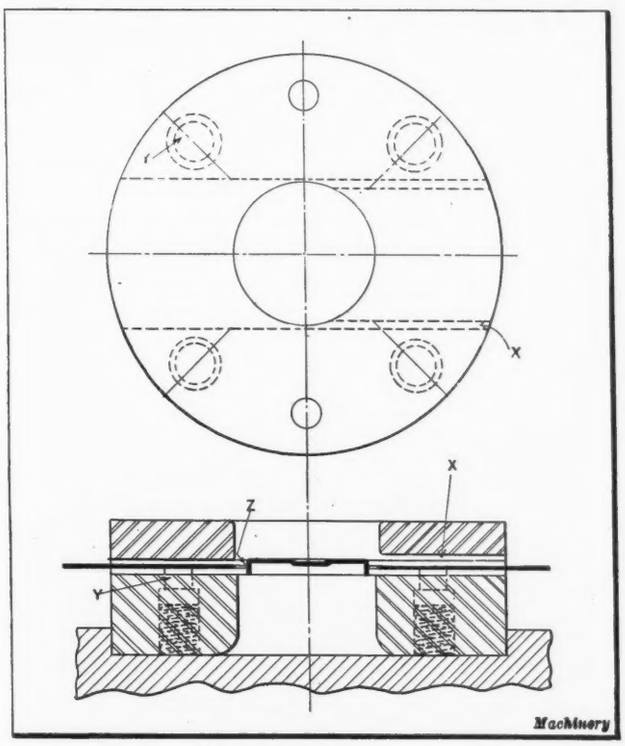


Fig. 3. Diagram showing Work in Position to be pushed from Die

* * *

THE INCREASING USE OF ALUMINUM

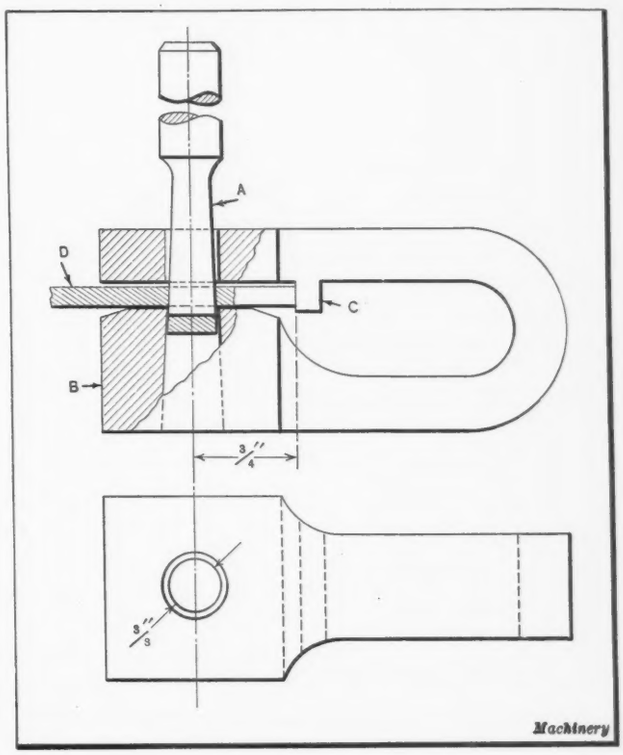
The development of the autogenous welding process and modern methods for making die-castings have greatly extended the application of aluminum in the industrial field. Sheet aluminum of all gages heavier than 1/32 inch are now readily welded by the oxy-acetylene flame, and the seam can be dressed off so well that it is difficult to locate the joint. Consequently, it is now possible to build aluminum tanks or containers of almost any size and shape, which, when welded, appear to be one piece. These tanks are practically leakproof, and for that reason have a marked advantage over riveted tanks. For a long time it was considered very difficult, if not impossible, to make aluminum die-castings, but at the present time several concerns are making such castings successfully.

PUNCHING EVENLY SPACED HOLES IN METAL SHEETS

By ANAK

The metal punching device shown in the accompanying illustration consists essentially of a punch *A* and a die *B*, with a guiding member for the punch and a stop *C* for locating the punch and die the correct distance from the edge of the sheet of metal *D* that is to be punched. The only tools available for making this punch and die were a small portable forge and a somewhat limited blacksmith's outfit. The punch was made up for a repair job that necessitated adding about 10 feet to a cupola shell which was 30 inches in diameter and made from 3/32-inch sheet metal.

For this job about 150 rivet holes, 3/8 inch in diameter, spaced 2 inches between centers at a distance of ¾ inch from the edges of the metal, were required to be punched. The die member was forged from a piece of rail steel and hardened. The punch was made from a piece of round carbon tool steel, ⅝ inch in diameter. The end of the punch was drawn down to a diameter of ⅜ inch and given a slight back taper.



Device for punching Holes in Metal Sheets

With this punch it was only necessary to locate one hole in each sheet by measurement. The stop *C* locates all the holes exactly ¾ inch in from the edge of the sheet. After punching the first hole, a short bolt was placed in the hole and a spacing block located against the head of this bolt. The die *B* was then brought into contact with the spacing block, which was made just thick enough to give a spacing of 2 inches between holes. This method of locating and punching the holes was found satisfactory, and no trouble was experienced after the sheets were bent and put in place ready for riveting.

* * *

In the tractor field it is said that a number of the larger makers will discontinue their smaller models, because the largest producer in the tractor field concentrates on a small size, and in view of his great production he is able to sell tractors at a price that makes competition very keen. The other manufacturers, therefore, are planning to build only the larger sizes.

Adjusting Milling Machines for High Speeds

Methods of Overcoming Difficulties Sometimes Met with when Milling Machines are Speeded up for Stellite Cutters

By C. W. METZGER, Haynes-Stellite Co., New York City

FROM time to time the Haynes-Stellite Co. receives complaints that properly ground stellite cutters fail to produce a good quality of finish and that the cutters are not uniform in quality. Investigation of such claims generally reveals the fact that the cutters are used on a machine that is improperly adjusted or that is not suited to high production work at the speeds and feeds used. In most instances of this kind the trouble can be easily located and remedied. It is the purpose of this article to outline some of the more common of these troubles that have come to the writer's attention, and explain how they were remedied, so that others who may be confronted by difficulties of a similar nature will know how to take steps to correct them.

In one case, a customer who was using a planer type of milling machine, equipped with one vertical spindle and two horizontal spindles, complained that the stellite cutter used on one of the horizontal spindles did not give a good finish and did not remain sharp nearly so long as the cutter on the opposite spindle. On investigating this complaint, it was found that the spindle of the cutter that gave trouble, which is shown diagrammatically at *A*, Fig. 1, was so far out of alignment with the table and the vertical bearing *B*, that spindle *C* was running hot and binding so tightly in the bearing that the cutter could not be raised to the desired height.

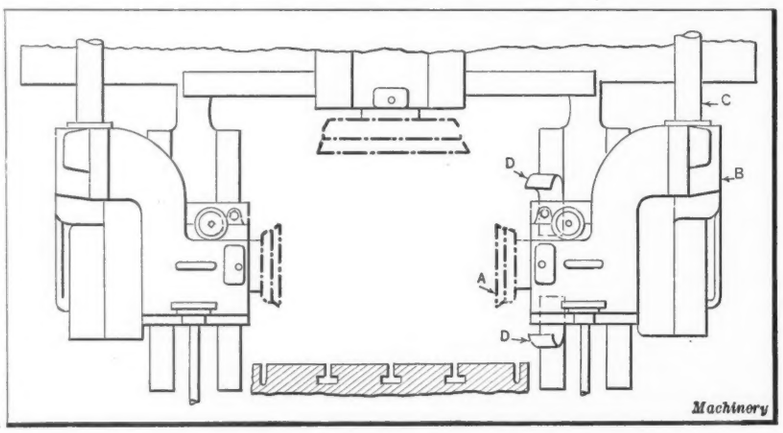


Fig. 1. Method of employing Shims D to realign Spindle Bearing

In order to remedy this trouble, shims *D* were used to bring the horizontal spindle—on which cutter *A* was mounted—into the correct position. As a result, the vertical spindle *C* ran free in its bearing and gave no further trouble. The cutter *A*, which had previously required grinding after every 125 cylinder blocks had been milled, stood up so well that after this adjustment 330 blocks were milled before resharpening was necessary. Incidentally, it may be mentioned that the cylinder block machined in this case was 30 inches long, the table travel 18 inches per minute, and the depth of cut ¼ inch.

It is well to remember that, if the spindle of a milling machine is out of alignment with the table to such an extent that the back of the cutter is in contact with the work, a double cut will be taken. This condition results in a poor finish and in greatly reducing the efficiency of the cutter. In some cases, where the spindle is inclined at a slight angle with the table, a specially ground cutter is necessary if the best results are to be obtained. The shapes or forms to which the cutters are ground to meet this and various other requirements are dealt with in an article published in April MACHINERY, on page 589.

Trouble Caused by Worn Spindle Bearings

In some cases where complaints have been made about the quality of finish obtained, it has been found that the trouble is due entirely to a worn or improperly adjusted spindle bearing. A spindle bearing of the type shown at *B*, Fig. 2, has sometimes been found to be free or loose in the taper bushing *A*. This allows an up and down movement of the cutter, which may be caused by the bevel gear drive at the top of the spindle.

If the bearing *C* is badly worn or needs adjusting, it will allow shaft *E* to spring or be distorted, as indicated by the dotted lines at *D*. This shaft, which makes two revolutions to one revolution of the cutter, will then exert an uneven driving pressure on the bevel gear at the top of the cutter-spindle. This causes the cutter to move up and down, and in some cases to run out of alignment, with the result that a poor finish is obtained and the efficiency of the cutter greatly reduced. Obviously, the remedy in cases of this kind is to renew the bearings or readjust them, making sure, of course, that the driving shaft and spindle are straight.

In one case where the finish obtained was not satisfactory, a simple adjustment of the spindle bearing eliminated all trouble. In this instance, the work being performed on the milling machine consisted of finishing the cylinder heads for the engines used in one of the highest grade automobiles made in this country. After the spindle had been properly adjusted, the finish obtained was all that could be desired. For this work a table travel of 34 inches per minute and a peripheral speed of 169 inches per minute for the cutter were employed.

Chatter Produced by Worn Gears and Overhanging Cutter-arbor

A cutter-arbor with too much overhang, as shown in Fig. 2, is often found to be the cause of chatter, which, of course, results in poorly finished surfaces. Worn or loose driving gears at *F* and *G* have also proved in some instances to be the cause of chatter. In cases where either or both of these conditions are found to exist in an old machine that has seen much service, it is generally advisable to use speeds that are considerably lower than those ordinarily recommended for stellite cutters. Under these circumstances the use of specially ground stellite cutters, as described in the article in April MACHINERY is also advisable. If the cut is intermittent and there is chatter and vibration caused by machine conditions or widely spaced teeth in the cutter, it is best to have a generous 45-degree chamfer at the ends of the cutter blades. Stellite cutters used in the manner outlined on old

or worn machines will prove a profitable investment in many cases, as they have a very long life. The high salvage value of the stellite blade stubs or short ends that cannot be used is a factor that should be remembered in considering the initial cost of a stellite cutter.

It may not be out of place to emphasize here the importance of carefully inspecting all milling cutters after they are resharpened or ground. Resharpened cutters should not be sent to the milling machine unless they have been inspected and found to run true and to have all their blades ground to the same height. Where a battery of milling machines is in operation on production work, it is a good plan to purchase an extra milling machine spindle and bearings complete, which can be mounted on a suitable fixture designed for indicating and inspecting the reground cutters. Then when a working spindle is in need of repair, it can be quickly replaced by the extra spindle. This allows production to continue uninterrupted, and sufficient time may be given to the repair and adjustment of the removed spindle to insure a high quality of work.

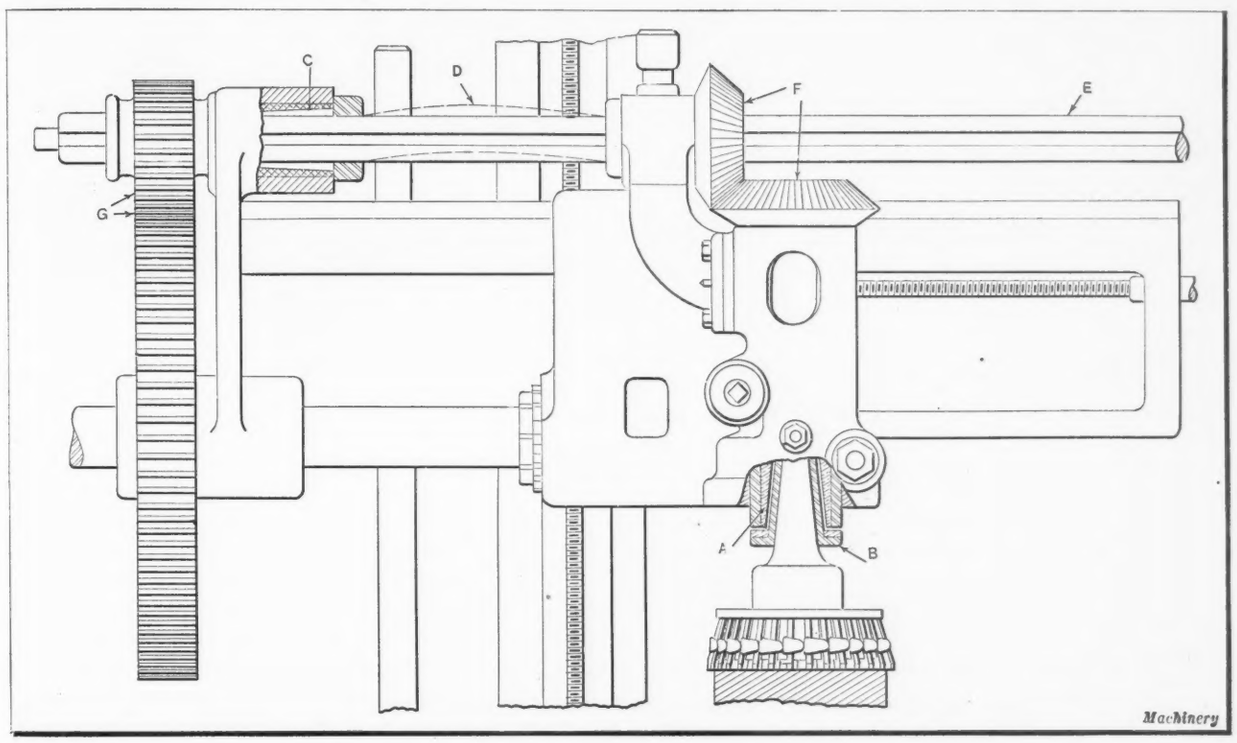


Fig. 2. Diagram showing Bearings or Members that must be properly adjusted

A word regarding the tolerances allowed on milling machine spindle bearings might also be included. The tolerances allowed should increase with an increase in cutting speed; for instance, it has been found that a tolerance of 0.005 inch on the spindle bearing is suitable when the cutting speed is 60 feet per minute, and 0.007 inch when the cutting speed is 100 feet per minute. At a cutting speed of 140 feet per minute a tolerance of 0.009 inch is suitable; and at a cutting speed of 180 feet per minute, a tolerance of about 0.011 inch may be allowed.

* * *

The decrease in efficiency of the workers in the German machine-building industry is indicated by some figures that are published in the report of the Association of German Machinery Manufacturers for 1922. The production per man is stated by giving the weight of the manufactured products per man. In 1910 the production per man, per year, was 6.9 tons; in 1912, 7.4 tons; in 1913, 7.7 tons; in 1921, this figure had decreased to 4 tons; and in 1922 it was only 3.9 tons.

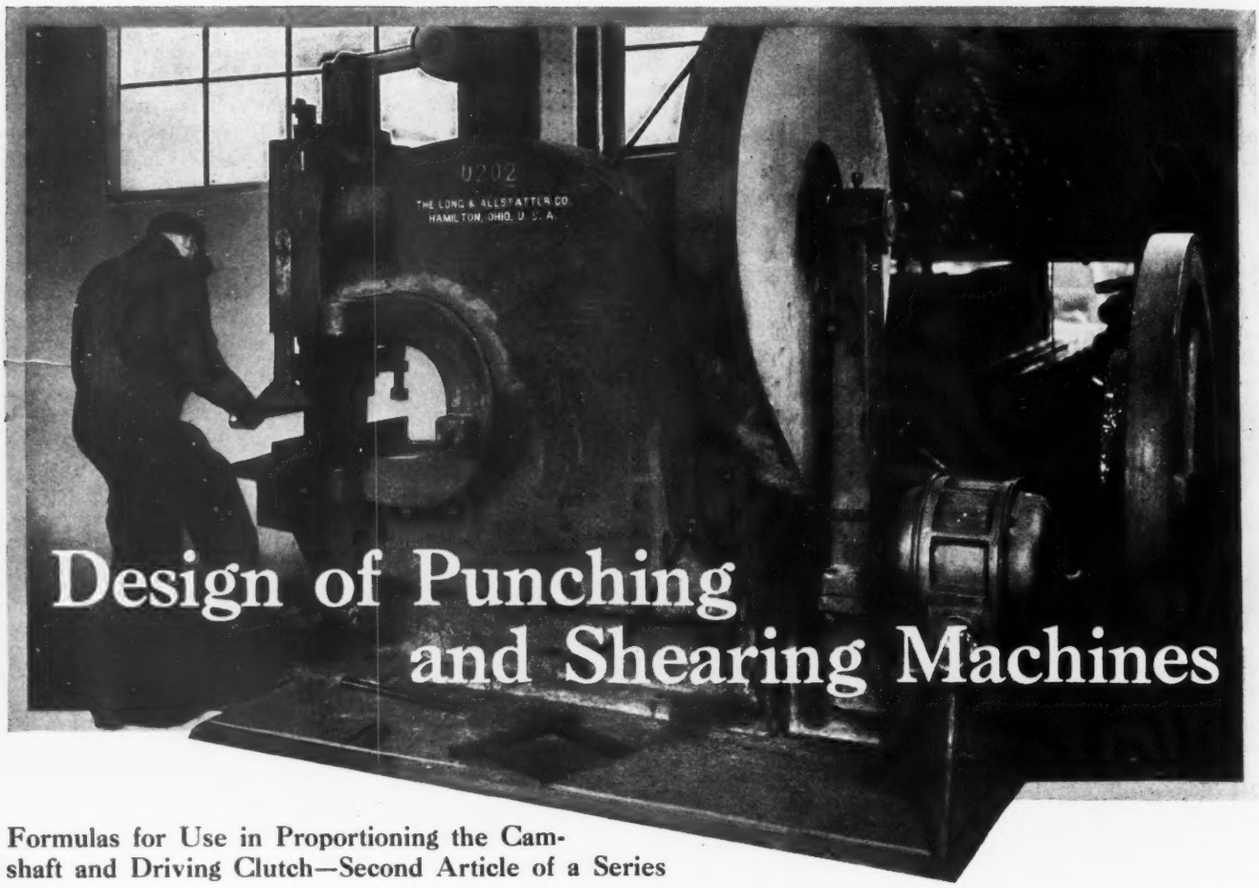
RECORDING PATENT LICENSES

A needless evil which should be remedied by patent legislation is pointed out by Professor Thomas A. Hill, counsellor at patent law, New York City. The fact that patent licenses and shop rights do not have to be recorded causes much needless litigation. Even patent transfers, except prior to subsequent assignment, need not be recorded. The result of this is that it is impossible for the prospective purchaser of any right under an invention or a patent to ascertain with certainty, in advance, the true state of the title. This incentive for fraud can and should be remedied by providing that every transaction affecting rights to a patentable invention be filed promptly for record in the Patent Office for public inspection, and those not so recorded should be held void as against any subsequently interested party adversely affected thereby.

As the law now stands, after a would-be patentee has exhaustively litigated his right to a patent for perhaps six to eight years in the Patent Office and Court of Appeals, he may have to litigate the question over again in the Federal Courts. This imposes unnecessary hardship, opens the way for fraud, and discourages legitimate progressive industry and invention. The merit of such laws is seriously questioned, and it is believed that steps should be taken to have them repealed.

As many patents are either invalid or of limited value, the Patent Office, when issuing them, should indicate the ascertained limitations, as notice to intending purchasers, licensees, and industry generally. This would involve practically no additional expense, and would obviate much fraud, misunderstanding, and subsequent litigation. The Patent Office is now made a source of revenue for the Government, and the public is left to the mercy of unscrupulous promoters, with no alternative except the hiring of patent lawyers, the expense of which is prohibitive to many people.

These are but a few of the bad features of our patent system, and until the investing public, the manufacturer, dealer, patentee, and technical fraternity realize these shortcomings and take the initiative many patent assets will remain of doubtful value.



Design of Punching and Shearing Machines

Formulas for Use in Proportioning the Camshaft and Driving Clutch—Second Article of a Series

By A. LEWIS JENKINS, Professor of Mechanical Engineering, University of Cincinnati

THE camshaft, or main shaft, of a punching and shearing machine is usually made of hammered steel of about 0.30 per cent carbon content. The most important variation in the details of this shaft is due to the different methods used in attaching the clutch. In some cases, the clutch is placed between the gear and the frame, and attached to the shaft by means of a feather key or by making the bore of the clutch sleeve and a portion of the shaft approximately square, as on the shaft shown at *X* in Fig. 1. In other designs, the clutch is on the opposite side of the gear from the frame, and is operated by a rod inserted in a hole through the shaft, as shown at *Z*, and connected with a sleeve placed in the opening in the frame and loose on the shaft.

The shaft illustrated at *X* is suitable for use with a clutch placed between the gear and frame. The gear fits on the extreme right-hand end, and the journals of lengths L_1 and L_3 fit in bearings in the frame. The cam is of length L and the faceplate journal of length L_4. The socket wheel or capstan is mounted on the extreme left-hand end. Diameter D of the cam is equal to the diameter of the eye in the pendulum, which was found in the first of this series of articles (published in July MACHINERY) to be

$$D = 3\sqrt{dt} + 1$$

in which d = diameter of hole to be punched, and t = thickness of plate. The length of the cam is equal to the width of the pendulum, the formula for which was also given in the preceding article. Thus,

$$L = 3.5\sqrt{dt} + 0.5$$

Some designers prefer to make the cam flush with the main journal, as shown at *Y*, in which case

$$D_1 = 2(e + 0.5D)$$

Value e was found in the previous article to equal $0.55\sqrt{dt} + 0.15$. Thus,

$$D_1 = 4.1\sqrt{dt} + 1.3$$

The decrease in the strength of the section between the cam and the main journal due to the sudden change in cross-section may be rendered less effective by joining the cam and journal with a fillet. In order to have a fillet, the diameter D_1 of the main journal should be increased about $0.4\sqrt{dt}$ which gives $D_1 = 4.5\sqrt{dt} + 1.3$.

Since the nearest eighths or sixteenths of an inch are used for e and D instead of the actual values given by the formulas, it is better to write this formula in the form,

$$D_1 = 2e + D + 0.4\sqrt{dt}$$

Another formula is obtained for this diameter by making $L_1 = 1.5\,D_1$ and allowing a bearing pressure of 4000 pounds per square inch. Then, assuming a load of 60,000 pounds per square inch of area punched,

$$D_1^2 = \frac{188{,}500\,dt}{1.5 \times 4000} \quad \text{and} \quad D_1 = 5.6\sqrt{dt}$$

This formula is satisfactory only for machines larger than for punching 1-inch holes through 1-inch plate. Its derivation will be understood by referring to the preceding article. Length L_1 of the main journal varies from $1.25D_1$ to $2D_1$. Making it equal to $1.5D_1$ gives

$$L_1 = 1.5D_1 = 6.75\sqrt{dt} + 1.95$$

When this formula is used, the bearing pressure varies from 2600 to 7000 pounds per square inch, the minimum applying to small machines and the maximum to very large machines.

Twisting and Bending Moments at D_2

That portion of the shaft of diameter D_2 is subjected to a twisting moment T, and also to a bending moment due to the thrust of the pendulum, reaction of the bearings, and the application of the load at the pitch circle of the gear, which makes it a continuous beam having three supports and two loads that are not applied in parallel directions.

The ordinary formulas for finding the bending moment of continuous beams apply only to beams of constant cross-section. In this case the cross-section is quite variable, making it necessary to introduce certain assumptions and make trial solutions, which result in a very long and laborious method. An actual working stress of about 8000 to 10,000 pounds per square inch should be used when bending is taken into consideration; however, it is better practice and about as accurate to neglect the bending moment and allow a unit shearing stress of 7000 pounds per square inch in the formula for torsional resistance. The twisting moment of the shaft is approximately equal to the product of the load W and the eccentricity of the shaft. Thus, $T = We$. Substituting this value of T in the formula for the diameter of a shaft subjected to twisting gives

$$D_2 = \sqrt[3]{\frac{5.1\ T}{q}} = \sqrt[3]{\frac{5.1 \times 188{,}500\ dt\ (0.55\ \sqrt{dt} + 0.15)}{7000}}$$

$$= 4.23\ \sqrt[3]{dt\ (\sqrt{dt} + 0.273)}$$

This formula is approximated by

$$D_2 = 3.75\ \sqrt{dt} + 1$$

Formulas for Finding Remaining Diameters and Lengths of Camshaft

That portion of the shaft between the diameters D_3 and D_1 of the shaft is sometimes made tapered. This may slightly reduce the cost of machining when the shaft is made from a solid bar having a diameter a little larger than the main journal, but in most cases it is considered good practice to remove the metal as shown, for the reason that it increases the resistance to shocks. It is not necessary to give this portion of the shaft as high a finish as is required on the journals. A fillet should connect diameters D_1 and D_2. Length L_2 depends upon the throat depth, and cannot be determined until the frame is designed.

Diameter D_3 is usually made slightly larger than D_2 to facilitate finishing the journal, but in some instances it is made smaller. Length L_3 is made from $2D_3$ to $2.25\ D_3$ which allows a bearing pressure of from 800 to 1200 pounds per square inch. An increase in the throat depth decreases the load on this bearing. For deep throats the total pressure is approximately equal to the force transmitted along the pitch circle of the gear. Diameter D_5 may be made equal to D_2. This portion is designed to receive the clutch, and if keys are used as shown at Y, it is desirable to place them either 90 or 180 degrees apart. The width of each key should be about $0.166D_5$; the depth, $0.28D_5$; the depth of keyway in the shaft, $0.133D_5$; and the length of the key should be sufficient to accommodate the clutch. The keys may be fastened to the shaft by machine screws.

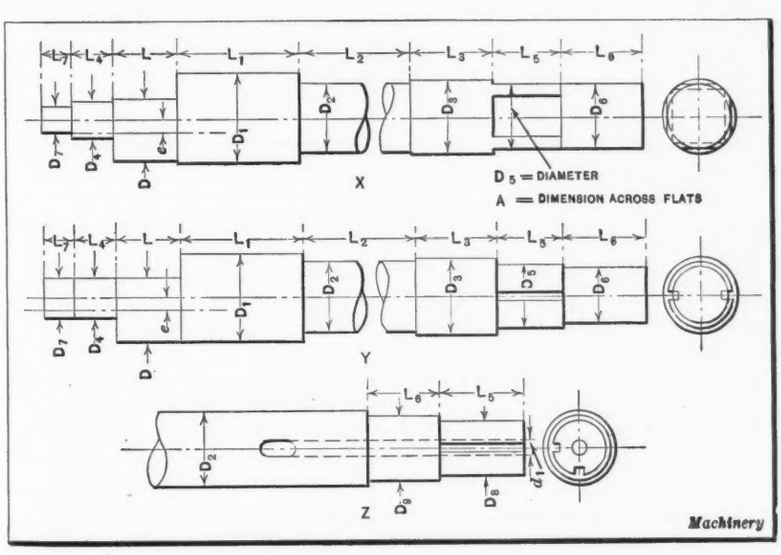


Fig. 1. Three Typical Designs of Camshafts on Punching and Shearing Machines

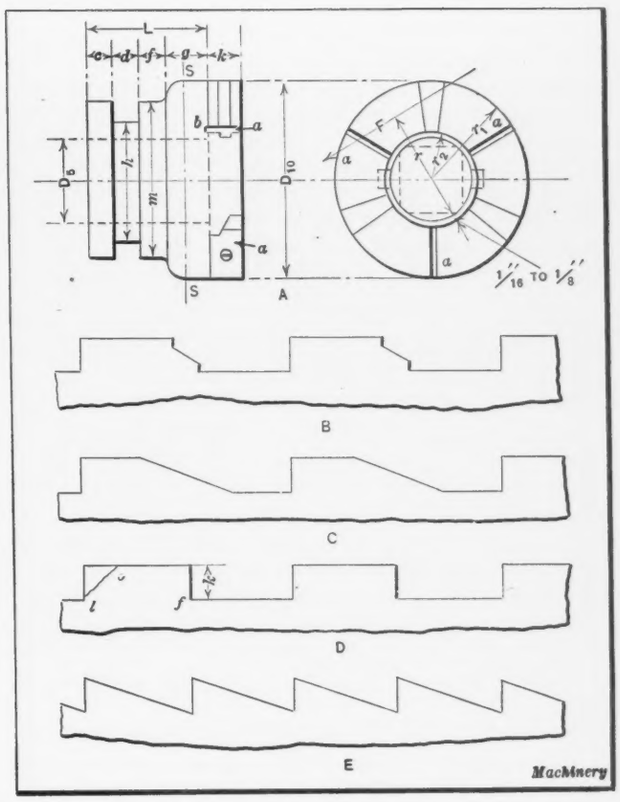


Fig. 2. Clutch Sleeve and Teeth commonly used on Punching and Shearing Machines

Many designers consider it better practice to make the shaft square for the clutch, with rounded corners, as shown at X, than to use keys. Distance A across the flats should equal $0.854D_5$. Diameter D_6 should equal A for a square clutch seat, and $0.9D_5$ when the seat is round, as at Y. Length L_6 should equal from $2D_6$ to $2.5D_6$, depending on the length of the gear boss. Diameter D_4 is found by a method similar to that used for D_1, and should be flush with D or only slightly smaller to allow for a fillet. Without a fillet,

$$D_4 = D - 2e = 3\ \sqrt{dt} + 1 - (1.11\ \sqrt{dt} + 0.3) = 1.89\ \sqrt{dt} + 0.7$$

Allowing for a fillet, $D_4 = 1.75\ \sqrt{dt} + 0.7$.

Length L_4 should be equal to D_4 to $1.25D_4$. Diameter D_7 fits into the bore of the socket wheel, and should be from $0.75D_4$ to D_4, the latter value being used by some designers for any size machine.

Length L_7 should be equal to D_7 to $2D_7$. When the clutch fits on length L_5 and the gear on length L_6, as at Z, the cam end and diameter D_2 should be the same as for the shaft at X. Other dimensions should be as follows: $D_9 = 0.85D_2$; $D_8 = 0.6D_2$; and $d_1 = 0.3D_2$.

The Socket Wheel

The socket wheel or capstan is fixed to the camshaft with a set-screw or key, being bored to fit diameter D_7, and it is provided with six holes for receiving the placing bar. Some capstans are connected to the shaft by a ratchet in order to prevent an accident in case the bar should be left in the capstan and the machine thrown in gear. A large handwheel instead of a capstan is provided on some machines.

Typical Clutch Operating Mechanisms

The simplest clutch operating mechanism consists of a sleeve similar to that shown at A in Fig. 2; this is moved into and out of engagement by two blocks which are segments of a ring that fits into a groove of diameter h and width d.

These blocks are attached by pivot screws *S*, Fig. 3, to a bellcrank which is operated by a link *K* connecting it with the treadle-lever. An automatic device for disengaging the clutch at any position of the slide is shown in Fig. 4. There is a face cam *F* attached to the clutch sleeve *A* by means of screws. The clutch is shown engaged, but when it rotates through nearly 180 degrees from this position, cam *F* strikes roller *B*, which is attached to the bellcrank *C*, pivoted at *G*, and causes the sleeve to move to the left and disengage. Engagement is effected by finger *E*, which is connected to bellcrank *C* through shaft *G*. When lever *D* is raised, the finger is pressed against sleeve *A*, forcing it to the right and engaging the clutch. Cam *F* may be so placed as to cause the clutch to disengage in any position.

In Fig. 3 the cam *F* is fastened to a sleeve *E* which is attached to the clutch sleeve *G* by set-screws. The clutch can be automatically disengaged and the slide stopped in any position by adjusting sleeve *E* on sleeve *G*. The clutch is engaged by raising link *K* attached to the treadle, which, in turn, raises plunger *L*, thus allowing spring *D* to swivel bellcrank *A* and force the clutch sleeve to the right. The lower end of plunger *L* then rests on the outer surface of sleeve *E* for one revolution, after which *F* strikes *L* and the sleeve is forced to the left and disengaged. A weight attached to lever *K* exerts sufficient pressure on plunger *L* to cause it to drop down on the face of sleeve *E*, as shown. On another clutch that functions on practically the same principle, a coil spring in the plunger bearing forces the plunger down against the sleeve face.

The automatic clutch shown in Fig. 5 is represented in the "out" position. To throw it into engagement, rod *R* is raised by means of a hand- or a foot-lever. This lifts plunger *P* carrying roller *L* and raises arm *A*, which allows spring *S* to move lever *B* to the left and press roller *E* against cam ring *F*. This cam is attached to the sliding element *C* of the clutch and forces it against the fixed element *D*. The end of roller *L* then rides on cam ring *F* until it passes cam *H*, when it drops on the right-hand side of the cam ring. At the same time cam *G* causes roller *E* to move to the left and lever *B* to the right, the latter movement stretching spring *S* and permitting arm *A* to lock lever *B*, as shown, when plunger *P* drops.

The clutch is thrown out of engagement at the proper time by cam *H* striking roller *L* and forcing the cam ring and sleeve *C* to the left. The machine may be safeguarded against being accidentally thrown into action while the operator is adjusting the dies, by raising lever *K* through 180 degrees. This releases the tension on the spring and there is then no force to throw in the clutch. Ordinary methods are used to connect sleeve *C* to the shaft and part *D*

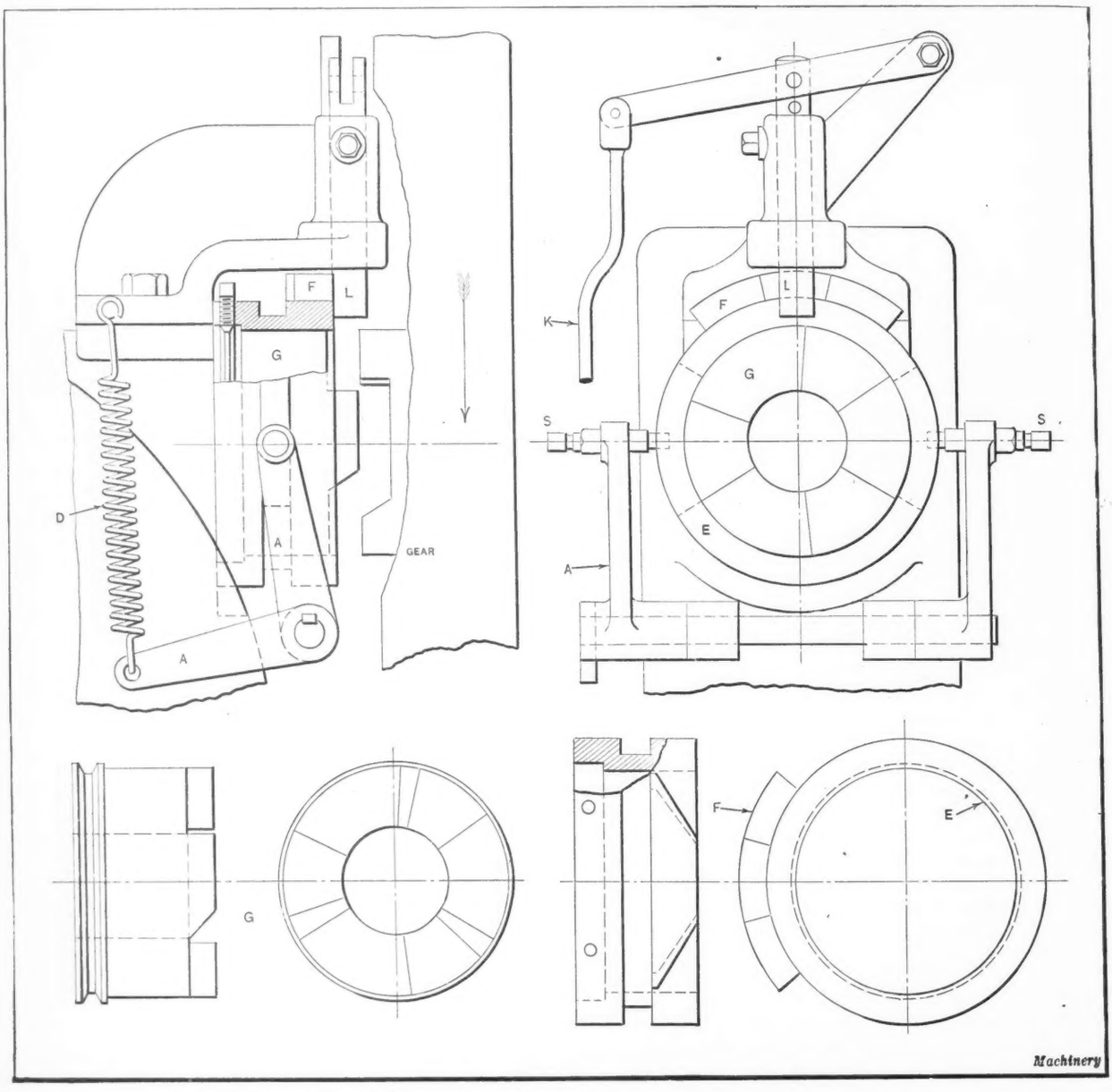


Fig. 3. Automatic Clutch Design in which the Clutch is engaged through the Action of a Coil Spring

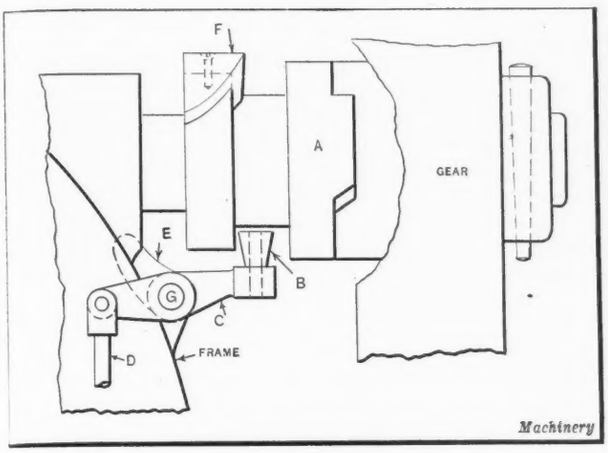


Fig. 4. Device for automatically disengaging the Clutch at Any Position of the Slide

to the gear. Cam ring F is adjustable on sleeve C by shifting set-screws N to the different holes T.

An example of a clutch on the end of the shaft instead of between the gear and the frame is shown in Fig. 6. The gear is loose on the shaft, but is prevented from moving to the right by a small collar M fastened to the shaft by set-screws. The clutch sleeve A may have a square bore or be provided with keyways to fit a sliding key or splines. Sleeve A is connected to sleeve D by a small rod which passes through a hole in the center of the shaft. The rod is held by nut B to a plate, and is fastened to sleeve D by means of keys or screws which pass through longitudinal slots in the shaft and cause sleeve D to turn with the shaft. Weights K act through bellcrank levers and tend to engage the clutch. The clutch is disengaged when a face cam on sleeve D strikes plunger H. By raising rod E, lever F is rotated, causing link G to draw plunger H away from the cam, and thus allowing weights K to engage the clutch.

Location and Teeth of the Clutch

The clutch may be placed between the gear and the frame, as shown in Figs. 3, 4 and 5, or on the end of the shaft, as shown in Fig. 6. The clutch teeth in most cases are the same, the only appreciable difference being in the operating mechanism. The clutch shown in Fig. 6, of course, requires a hole in the shaft and an opening in the frame, which makes it cost more to construct, but it brings the gear nearer the bearing in the frame and thereby decreases the bending moment on the shaft. The part that mates with the sleeve at A, Fig. 2, is attached to the gear, and may be either cast to it or fastened by means of screws or bolts and lugs similar to those used in connecting the faceplate to the frame, as described in the preceding article. If made separately, it will be the same as if the sleeve at A were cut off along line S–S and provided with lugs and bolt holes. It is apparent that the teeth on the piece that fits on the gear are not identical with those on A, but are opposite.

The working faces of the teeth at A are made of hardened steel plates a, which are assembled by means of screws and lugs, the width of the plates being a little greater than dimension k to allow them to set into the clutch at b. The plates are made symmetrical so that they may be turned around when worn. Some types of teeth used on these clutches are shown at B, C, D, and E. The teeth shown at D are frequently used, but unless there is considerable clearance or backlash, they will not engage readily at high speeds. This objection is somewhat overcome in the teeth at B and C and entirely so in the teeth at E. From this it may be seen that the shape of the teeth should depend upon the speed at which the clutch must engage. Proper engagement is satisfied with the teeth at C, but the clutch may not be as strong as one having teeth such as shown at B. The advantages of the latter type are that they have sufficient strength, can be readily engaged at speeds up to 50 revolutions per minute, and permit of turning the machine backward by hand.

Clutches with teeth as shown at B, C and D should have from $\frac{1}{8}$ to $1\frac{1}{4}$ inches clearance or backlash between the teeth, depending on the size of the machine. This means that the space between any two teeth should be greater than half of the circular pitch of the teeth. Another consideration is the strength of the teeth. If the clutch is made of cast iron, each tooth will tend to fail along a line lo at D unless lf is less than about $1.5k$. In the strongest clutch lf would probably be made almost equal to k, which would require a greater number of teeth and thereby decrease the delay in engaging, but it has been found unnecessary to have more than four teeth on clutches for punching and shearing machines, and a greater number is less likely to give an equal distribution of the load.

The number of teeth depends upon the size and speed of the machine. It is good practice to use two teeth on machines for punching 1-inch holes through 1-inch plate or less; three teeth on machines between that size and the size for punching 3-inch holes through 1-inch plate; and four teeth on larger machines. There should be from 1/16 to $\frac{1}{8}$ inch clearance between the inside of the teeth and the shaft; hence, the inside radius is:

$$r_2 = 0.5D_5 + 0.0625 \text{ to } 0.125$$

The outside diameter of the clutch is:

$$D_{10} = 2D_5 + 1$$

Dimension k should be as small as is consistent with strength, since large values of k require too great a travel for engagement and disengagement, and may decrease the strength of the teeth; too large values of k also require that the gear be placed too far from the rear bearing in

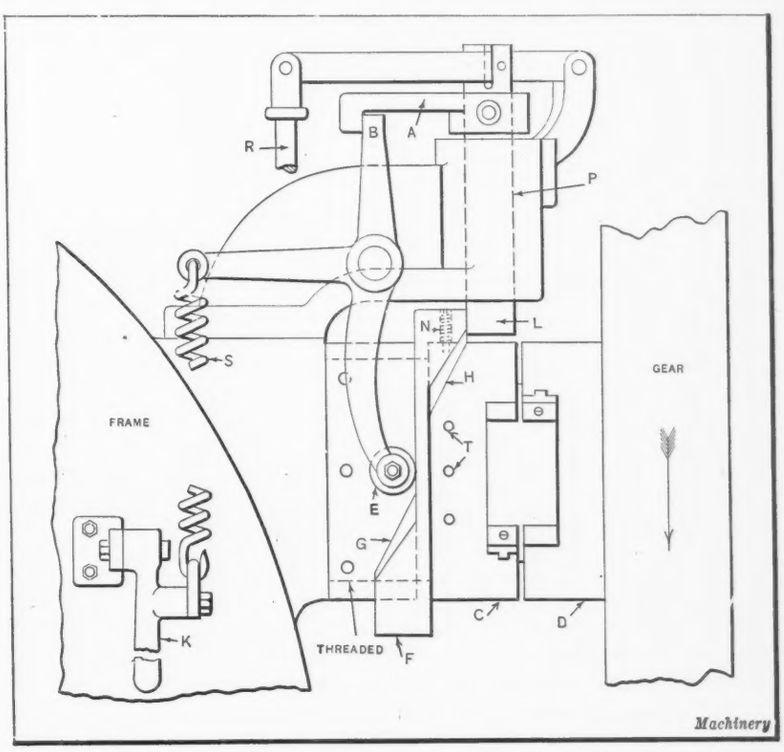


Fig. 5. Automatic Clutch which is engaged and disengaged by Means of Two Rollers contacting on Opposite Sides of a Cam Ring

the frame when the clutch is placed between the gear and the frame.

The twisting moment T on the shaft may be taken as equal to the pressure between the teeth times their mean radius r. Hence

$$T = Fr = F \times \frac{(r_1 + r_2)}{2} \quad \text{and} \quad F = \frac{2T}{r_1 + r_2}$$

in which F = force acting tangent to pitch circle of teeth. The total area of the tooth bearing surface is $n\ (r_1 - r_2)\ k$, where n is the number of teeth.

The unit pressure p on the teeth is

$$p = \frac{\text{load}}{\text{area}} = \frac{2T}{(r_1 + r_2)\ (r_1 - r_2)nk} = \frac{2T}{nk\ (r_1^2 - r_2^2)}$$

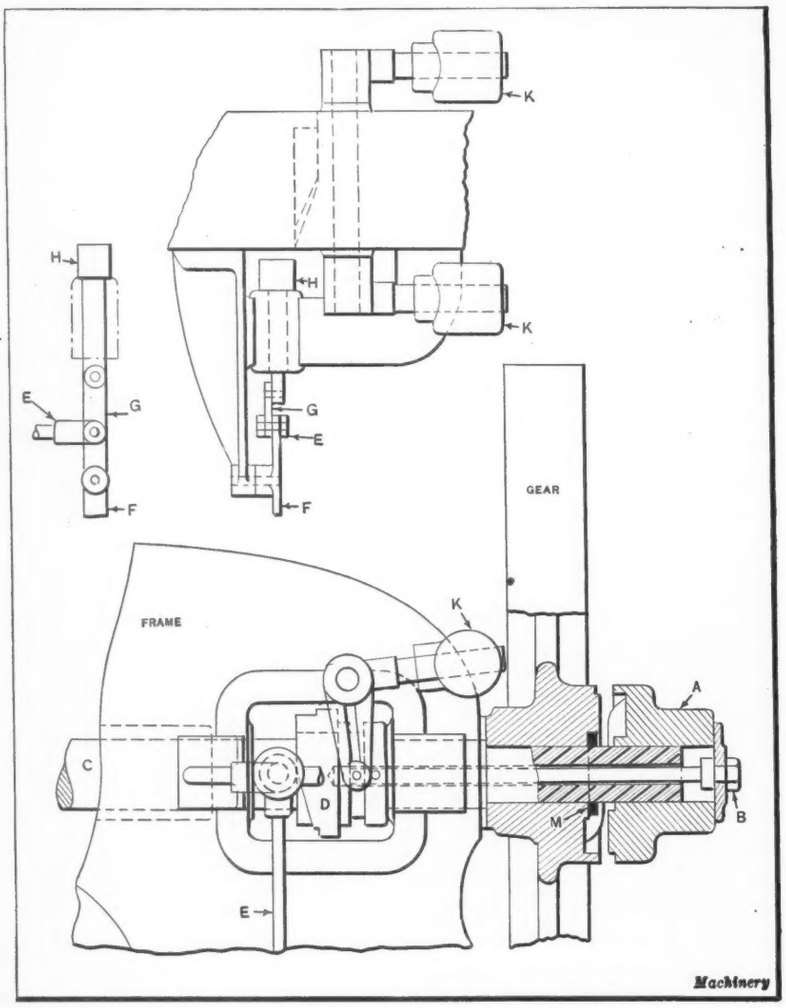


Fig. 6. Design in which the Clutch is located on the Opposite Side of the Gear from the Frame

and

$$k = \frac{2T}{pn\ (r_1^2 - r_2^2)}$$

Substituting the values of T, r_1, and r_2 gives

$$r_1 = \frac{D_{10}}{2} = \frac{2D_5 + 1}{2} = \frac{2(3.75\ \sqrt{dt} + 1) + 1}{2} = 3.75\ \sqrt{dt} \times 1.5$$

$$r_2 = \frac{D_5}{2} + 0.125 = 1.875\ \sqrt{dt} + 0.625$$

Then assuming a load of 60,000 pounds per square inch of area punched,

$$k = \frac{(188{,}500dt\ (1.11\ \sqrt{dt} + 0.3)}{(10.5dt + 8.9\ \sqrt{dt} + 1.8)\ np}$$

The value of p may be 3500 pounds per square inch for three teeth, and 4500 pounds per square inch for two teeth; however, values as low as 2000 pounds per square inch are used on small machines.

The operating clutch piece or sleeve may be provided with keyways for feather keys or splines, or have an approximately square bore, as shown dotted in Fig. 2 at A. The size of the square hole would be the same as dimension A, Fig. 1. When only one key is used, it should have a breadth equal to $0.25D_5$, and a thickness equal to $0.3D_5$. The depth of the keyway in the clutch should equal $0.175D_5$. When two or more keys are used, the breadth should equal about $0.166D_5$; the depth, about $0.28D_5$; and the depth of the keyway in the clutch, $0.147D_5$.

Length L (Fig. 2) of the clutch should be sufficient to allow a shearing stress of from 5000 to 6000 pounds per square inch on the key or a crushing stress of from 7000 to 8000 pounds per square inch. When two keys are used, the shearing stress per square inch is usually about 4000 pounds and should not exceed 6000 pounds, while the crushing stress per square inch should not exceed about 5000 pounds. If a square shaft is used, L_5 should be made equal to $1.25D_5 + 0.5$. Dimensions c, d, f, g, h, and m have no rational basis of calculation except that g should equal at least $1.5k$ if m is appreciably less than D_{10}. The attaching of automatic stopping devices changes these proportions considerably, and so none are standard. The following values may sometimes be used: $h = 1.5D_5 + 1$; $c = d = 0.1875D_5$; and $g = 0.3D_5 + 0.3$.

The Camshaft Collar

When the clutch is located between the frame and the gear, it is necessary to use a plain collar on the end of the shaft to hold the gear in place. The inside diameter, of course, is made to suit the diameter of the end of the shaft, while the outside diameter may equal $1.5D_6$ and the width, $0.5D_6$. The collar is fastened to the shaft by means of set-screws (preferably headless) having a diameter equal to about one-fourth the collar width or by means of a taper pin having a taper of ¼ inch per foot.

* * *

A SALESMEN'S SCHOOL

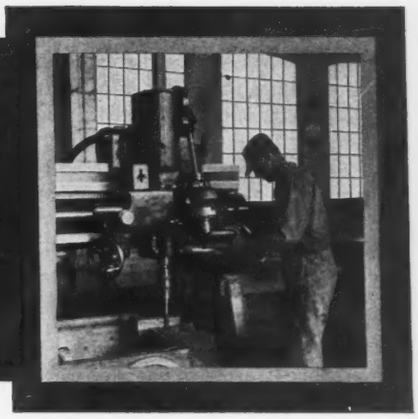
A salesmen's school is being conducted by the Link-Belt Co. of Chicago, in which the new men added to the company's sales force, regardless of their previous experience or training, are instructed in the company's policies and standards of practice, educated in regard to the design and construction of the machinery and equipment built by the company, and thoroughly trained in the company's sales methods. The salesmen from the company's branch offices are taken to visit one of its factories, where they can see and inspect the methods of manufacture, as well as to interchange ideas among themselves. The course takes but a comparatively brief time, but a complete schedule is covered during the few days devoted to the training.

* * *

According to an article by E. E. Rohrer of the Coatesville Boiler Works, appearing in *Chemical and Metallurgical Engineering*, the efficiency of the lapped and single-riveted joint is approximately 50 per cent. The lapped and staggered double-riveted joint has an efficiency of about 70 per cent. The butt-strapped, double-riveted joint has an efficiency of about 82 per cent; the butt-strapped, triple-riveted joint, an efficiency of about 87 per cent; and the butt-strapped, quadruple-riveted joint, about 93 per cent.



Letters on Practical Subjects



RADIUS MILLING FIXTURE

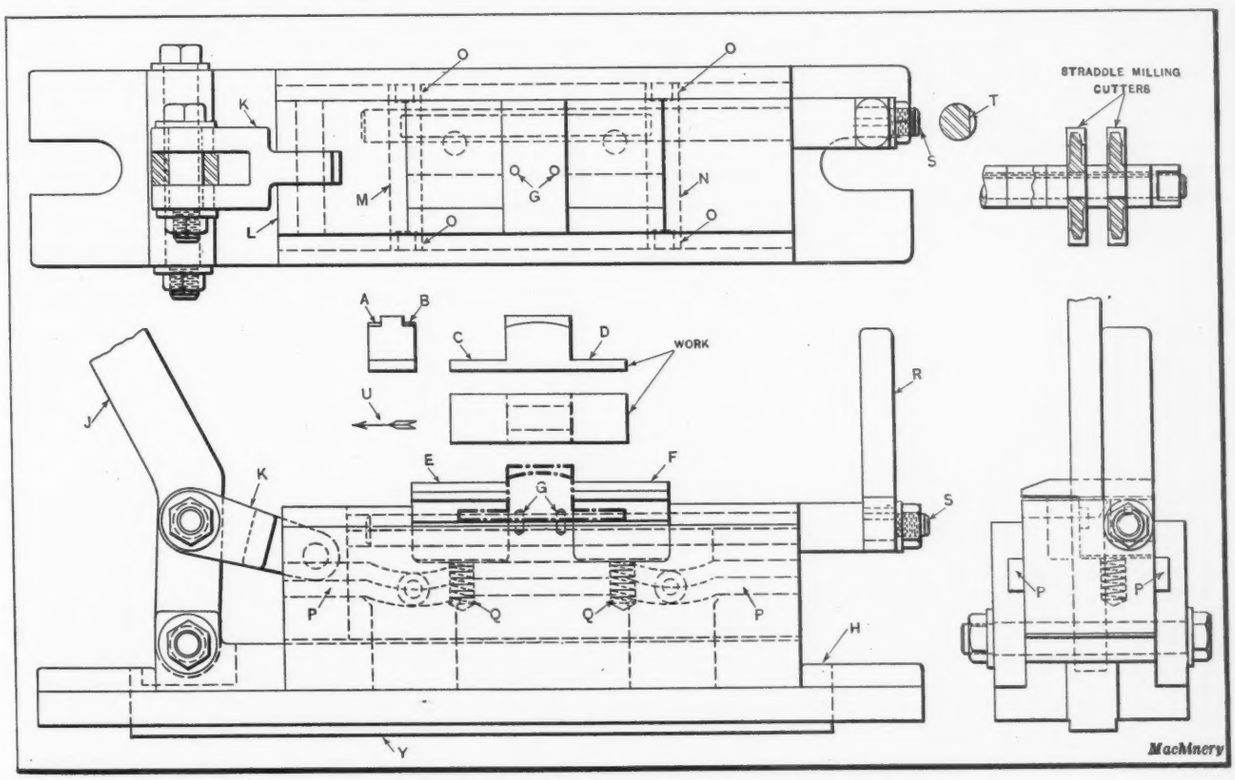
While milling machines are not usually fitted for doing radius milling with straddle cutters, it is nevertheless possible to equip them with special fixtures that will permit such work to be economically and conveniently done. A fixture designed for a case of this kind is shown in the accompanying illustration. The part to be machined is shown by heavy dot-and-dash lines. The surfaces *A* and *B*, as indicated in the end view of the work, are the ones to be radius-milled by the straddle cutters which are shown in the upper right-hand corner of the illustration. The work is clamped in place by blocks *E* and *F*, which are tightened on the flanges *C* and *D*. The raised central part of the work is located between the clamping blocks. When the fixture is being loaded, the work is slid back until it comes in contact with stop-pins *G*.

The cast-iron base *H* is clamped in position on the milling table after being located in the correct position under the cutters. The entire milling operation is performed by operating the lever *J* on the fixture, which is connected to a link *K*, the latter, in turn, imparting a longitudinal movement to block *L*. Mounted in this block is a pair of studs *M* and *N*, fitted with rolls *O* at each end. These rolls travel in grooves *P*. As parts of these grooves are milled concave, or to a radius corresponding to that to be milled on the work, the block *L* is given the vertical up and down movement necessary to mill the work to the required radius when the block *L* is traversed in its slide.

Two springs *Q* are provided to hold the clamping blocks *E* and *F* in a raised position so as to facilitate sliding the work into the fixture. A lever *R*, keyed to a shaft *S* which has a flattened portion, such as indicated at *T* in the sectional view, actuates the clamping blocks *E* and *F*. A downward movement of lever *R* causes the clamping blocks to grip the two flanges *C* and *D* of the work. This clamping device holds the work securely in position and can be operated very quickly.

After clamping the work in place, the operator presses down on the long lever *J* which has a handle (not shown) at its upper end. This causes the block *L* on which the work is clamped to slide in the direction indicated by the arrow *U*. This feeding or sliding movement starts from a point to the extreme right of the position shown. As the work is thus passed under the revolving cutters, the part is formed to shape, due to the vertical movement imparted to the work-holding block by the guide grooves *P*. Fixtures of the same general nature can be used successfully for a large variety of work.

F. SERVER



Fixture employed in performing a Radius Milling Operation with Straddle Cutters

TRIMMING DIE FOR METAL COVER

The die shown in the accompanying illustration is used for trimming the flange *A* from the lower edge of hexagonal shaped covers, such as the one shown by the dot-and-dash lines at *B*. The lower cutting die *C* is a hardened tool-steel ring, which is located on the cast-iron base *D*, and held in place by the pad *E* and the fillister-head screw *F*. The trimming die was originally made in the form of a hardened tool-steel block, which was screwed to the baseplate. The objection to this arrangement was that the die had to be annealed, upset, rehardened, and reground whenever it became dull. The ring type of die is made with straight sides, so that when one edge is dulled, the die can be reversed, thus making it necessary to sharpen it less frequently. The upper die *J* is made of toughened tool steel, and when it becomes dull, it can be upset while in place and a new cutting edge sheared on its end.

A half-cover *G*, with a handle soldered to it was used at first to put the work on the locating pad. This served to keep the hands of the workman away from the die, but slowed up production considerably. As a result, this safety device was often laid aside by those engaged in piece-work. In order to avoid accidents, the double-deck chute, consisting of slides *H* and *L*, and the feed-slide *I* were attached to the die. The feed-slide proved to be a practical safety device, and it also served to increase production. With this equipment, the operator could use one hand to keep the chute filled with pieces, and control the feeding of the pieces into the die with the other hand. This arrangement permits the press to be run at a speed of 90 strokes per minute.

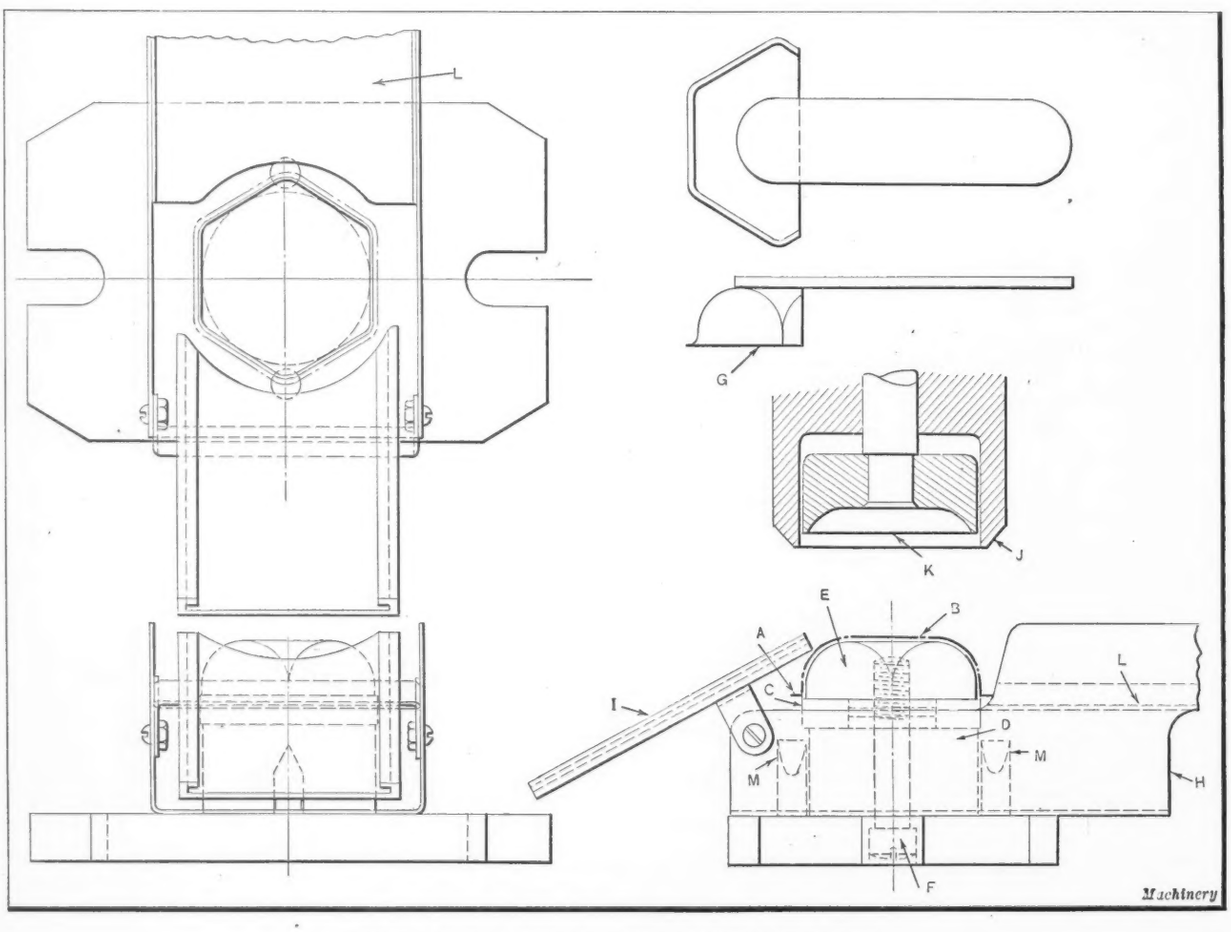
When the operator liberates a cover, it slides down the chute *I* and locates itself on the pad *E*. The press is, of course, inclined at the proper angle to permit feeding the work into place in this manner. When the upper cutter *J* descends, it performs the trimming operation, and as it ascends it picks up a trimmed cover. When the upper cutter is near the end of its upward stroke, the knock-out *K* pushes the cover into the upper chute, so that it slides down into a receptacle at the back of the press. As the operation continues, the trimmings accumulate on the base of the lower die, until they have become packed so tightly between the two cutters *M* and the cover being trimmed that they are split in two, so that they drop into the lower chute *H* and from there slide into a scrap-box.

Brooklyn, N. Y. S. A. McDONALD

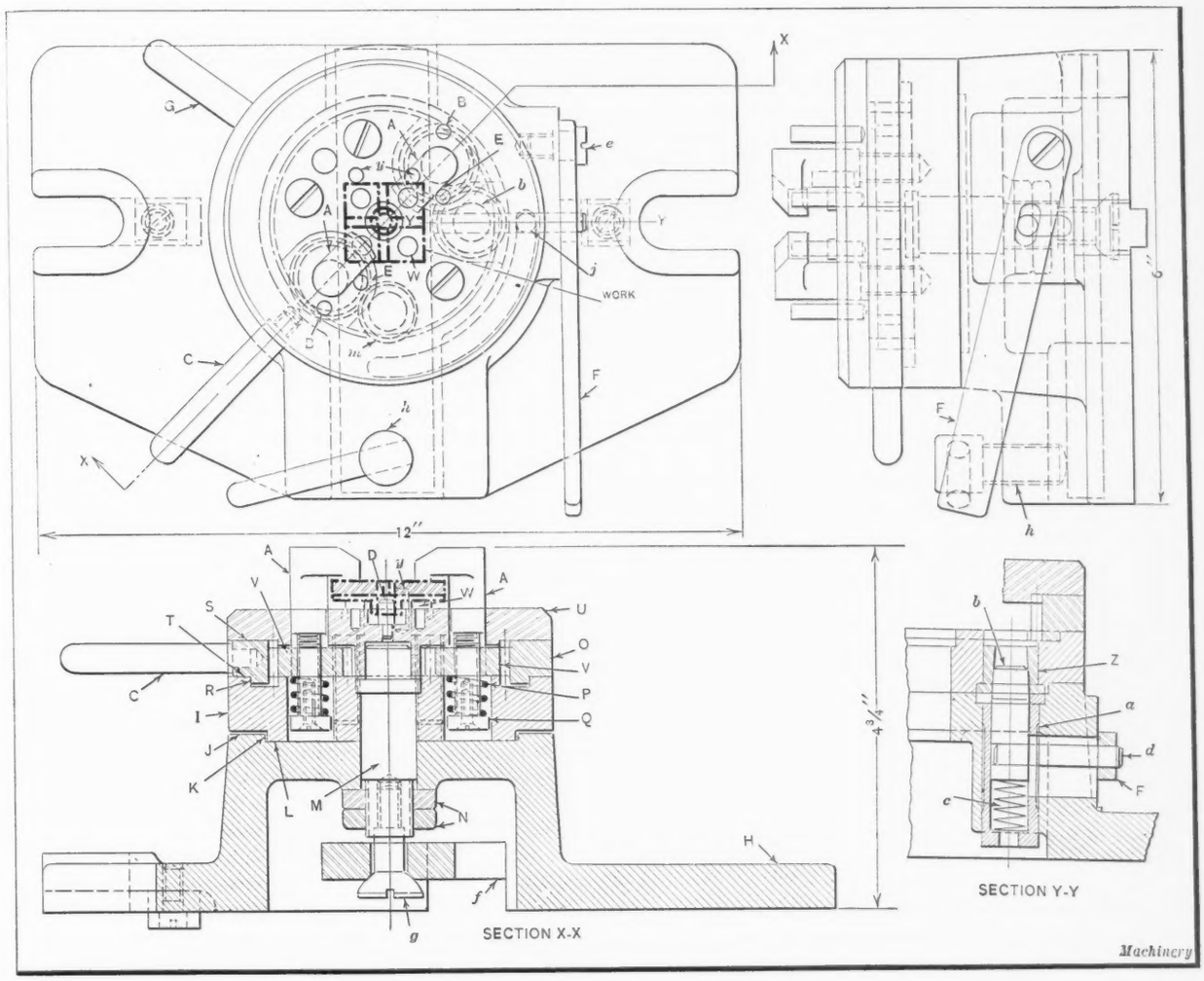
INDEXING FIXTURE FOR MILLING GENEVA STAR-WHEELS

The milling fixture illustrated herewith is employed in the production of star-wheels for Geneva movements. The operation performed in this fixture is the milling of the track slots for the propeller pin. The wheel—shown by dot-and-dash lines—comes to this fixture with the front face, sides, rear face, and hub machined to finished dimensions. The two hook-bolts *A*, which clamp the work in place, are swung on their shanks until stopped by pins *B*, when lever *C* is swung in a clockwise direction in order to release the work. This opening movement of the jaws of the hook-bolts permits a new piece of work to be readily put in place over the pilot-pin *D*.

A movement of lever *C* in a counterclockwise direction swings the clamping ends of the hook-bolts back into place, where they are stopped by pins *E*. A further movement of lever *C* serves to draw the hook-bolts down, so that the work will be clamped in place. After one track slot has been milled in the star-wheel, the lever *F* is depressed to disengage the index-pin. The work-holding member of the fixture is then revolved 90 degrees in a counterclockwise direction by means of lever *G*, which is attached to the index-ring *I*. The index-pin is then raised to lock the fixture by an upward movement of lever *F*.



Die for trimming Flange from Hexagonal-shaped Metal Cover



Indexing Fixture employed in milling Geneva Star-wheels

Part *H* of the fixture is a cast-iron base having a circular recess in which the index-ring *I* rides. This ring has a clearance at points *J* and *K* and bears on the face *L*. In the center of the ring is a hardened and ground pilot-stud *M*, which is a press fit in the index-ring and a running fit in the base. It is held in the base by the two threaded collars *N*. On the upper face of the index-plate is an annular recess which receives the internal ring gear *O*. Two clearance holes are bored to receive the springs *P* and the spring caps *Q* which are made a sliding fit in the holes in the index-ring. The ring gear is made a close fit at point *R*, but clearance is allowed at points *S* and *T*.

To the top of the ring gear is fastened the cover plate *U*, which has a recess on its under side to receive the ring gear. There are also two circular pockets in the cover plate to receive the two spur gears *V* which engage the teeth of the ring gear. Sufficient clearance is allowed between the cover plate and the index-ring for the spur gears and the ring gear. The cover plate is fastened in place by suitable screws and dowels. The holes in the spur gears are threaded to receive the threaded ends of the hook-bolts *A*, and the body part of the hook-bolts is made a sliding fit in the two holes in the cover plate. In the center of the cover plate is a pilot-pin *D* on which the part to be milled is located. Four supporting pins *W* and two gage pins *y* are provided to support the part and locate it squarely in the fixture.

The indexing arrangement is shown in the partial sectional view in the lower right-hand corner of the illustration. Two holes 90 degrees apart are bored in the index-plate to receive the tapered index-pin bushings *Z*. Directly below bushing *Z* a hole is bored in the base to receive the plunger bushing *a* in which is inserted the plunger *b* and the plunger spring *c*. On the side of the plunger bushing *a* is an elongated slot through which passes plunger pin *d* which is connected to lever *F*. Lever *F* is pivoted on pin *e*. To the bottom of the pilot-stud *M* is fastened a clamp *f*, which is held in place by the spherical head of stud *g*. The clamp has a spherical depression in it to correspond with the spherical head of stud *g*. A clamping screw *h* shown in the view in the upper right-hand corner of the illustration bears on the front end of this clamp, while the back end of the clamp has a bearing on the base of the casting and is prevented from sidewise movement by a recess cut in the base.

The method of operating the fixture is as follows: In loading, a movement of lever *C* serves to turn or pivot the hook-bolts until their clamping ends are stopped by the two pins *B*. The part to be milled is then inserted over the pilot-pin *D*. The work is squared up in the fixture by the two gage pins *y*, so that it rests on the four supporting pins *W*. The operator then grasps the handle *C* and turns or rotates the gear ring *O* in a counterclockwise direction so that the two pinions *V* will be rotated in the same direction. The pressure applied by springs *P* causes the hook-bolts to turn with the pinions until they strike the stop-pins *E*. Any additional movement of lever *C* will cause the pinions to rotate, and as they are threaded on the hook-bolts *A*, the latter will be drawn down so that their hooked ends will clamp the work firmly in place.

The clamping screw *h* is then tightened to insure rigidity of the indexing part of the fixture, after which the first slot in the star-wheel is milled. For milling the second slot, screw *h* is released and lever *F* pressed down with the right hand, while the handle *G* is swung around in a counterclockwise direction until the bushing *m* is directly above the plunger *b*. At this position the plunger enters bushing *Z*, thus locating the work for the second cut in the star-wheel,

which is exactly at right angles with the first cut. Then the clamping screw *h* is again tightened, and the second cut taken. In order to release the piece after the milling operation, handle *C* is swung in a clockwise direction, causing the hook-bolts to rise and swing outward, so that the operator can easily remove the finished part and insert a new piece.

The indexing movement of the fixture is limited to 90 degrees by the pin *j*, which projects into a circular slot cut in the under side of the index-ring. A greater indexing movement would cause the plunger to drop into the holes which provide clearance for the hook-bolts. Chips are prevented from entering the internal mechanism of the fixture by the cover plate. It will be noted that the complete operation of unclamping the hook-bolts and swinging them out of the way is accomplished by a 90-degree movement of handle *C*.

Brooklyn, N. Y. JOHN A. HONEGGER

FORMULA FOR FINDING CREST RADIUS OF WHITWORTH THREADS

A formula for finding the radius at the top of a modified Whitworth thread is presented in this article with the hope that it will prove useful to many readers of MACHINERY. The formula and its derivation can best be explained by considering its application to a tap with Whitworth threads, but it is equally useful when applied to hobs, cutters, etc., that have Whitworth threads or threads of a similar form.

All taps are made with a greater limit on the outside diameter than on the pitch diameter. In fact the outside diameter should be large enough to cut a clearance so that the sides of the assembled screw and nut will be in contact without any interference at the top and bottom of the threads. If this clearance is considerable, the radius at the top of the thread on the tap must be reduced. The problem in this case is to find the required radius *R* (see illustration) so that a suitable forming tool can be made.

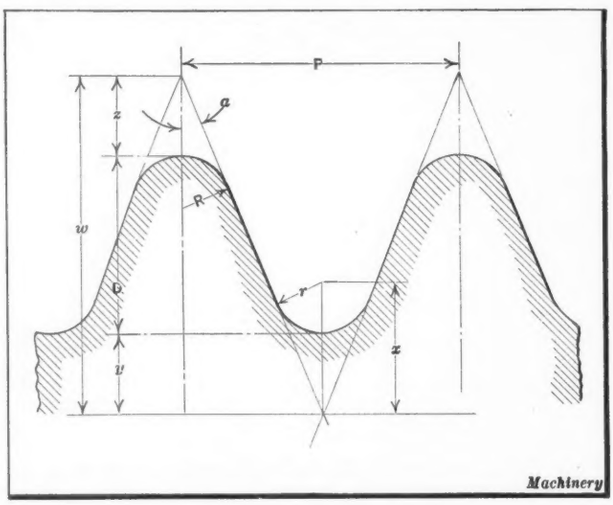


Diagram used in Derivation of Formula for finding Crest Radius

For this problem we have given the following values:

a = one-half the thread angle;
r = standard radius for given pitch;
P = pitch; and
D = depth of thread.

We also have:

$$x = \frac{r}{\sin a} \qquad y = x - r$$

$$w = \frac{P}{2 \times \tan a} \qquad z = w - (D + y)$$

The value of *R* can now be found by trigonometry and algebra. Referring to the illustration, we have:

$$\frac{R}{R + z} = \sin a$$

$$R = R \sin a + z \sin a$$

$$R - R \sin a = z \sin a$$

$$R\ (1 - \sin a) = z\ \sin a$$

Thus

$$R = \frac{z \sin a}{1 - \sin a}$$

The latter formula also applies in the case of a roughing tap where the depth of thread is decreased. It has proved very useful to the writer in finding the radius of standard Whitworth thread taps where the threads are cut at such a steep helix angle that the form of the tool for threading the tap must be corrected. HARRY BURTON

DRAWING IRREGULAR CURVES

Many draftsmen employ a large assortment of fixed curves or celluloid templets in making various kinds of drawings. The writer has found that in some cases the common soldering metal used by electricians can be employed to good advantage in place of the fixed curves or templets. This soldering metal can be obtained in round wire form, about $\frac{5}{32}$ inch in diameter, and is very flexible. It can be bent to any desired curve within certain limits with the fingers. Provision for holding the wire solder is made by drilling a small pin hole through the wire about ¼ inch from the end for a swivel point. The other end can be held in place with the fingers, thus leaving one hand of the draftsman free to use either a ruling pen or a pencil.

The wire solder may be so bent or formed that it can be used in connection with the T-square. For instance, after a portion of the solder has been formed to some desired curve or series of curves, the remaining portion can be so bent that it can be guided or located by the T-square in different positions, the same as a triangle. When the wire solder becomes kinked, it is an easy matter to straighten it by drawing the wire through the hands and then rolling it between two boards. Aluminum wire can also be used for the same purpose, but it is more difficult to straighten when it has become kinked. The round section of the wire facilitates the use of a ruling pen and eliminates the danger of blotting.

North Andover, Mass. CHARLES P. THIEL

SEPARATING STEEL CHIPS FROM OIL

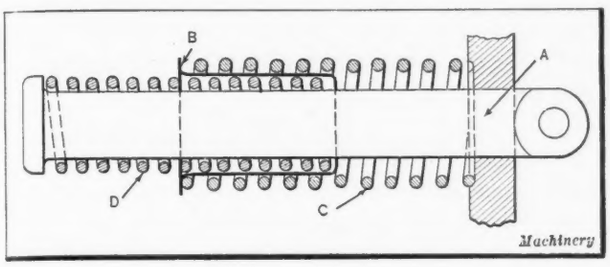
In a plant engaged in the manufacture of an automotive accessory, it was found that there was a considerable waste of oil in one of the processes. This oil was used for burnishing and for maintaining an even temperature while the product was being gaged for size. Large quantities of dust and fine steel chips were picked up by this oil, so that it could not be used over again without being filtered. As the chips were so fine that they would not settle or separate from the oil readily, representatives of various companies selling mechanical filters were called in to deal with the problem, but all failed to filter the oil successfully. The members of the works laboratory were finally given the job, and they solved the problem by using a wick to feed the oil into an ordinary laboratory filter paper. The filter worked automatically and the only expense involved was the use of two sets of filter papers a week. About 2500 gallons of this oil were purchased a year, and 2184 gallons were taken from the filter and used again. This represented a saving of $340 a year on this one item.

Philadelphia, Pa. ARTHUR L. COLLINS

Shop and Drafting-room Kinks

DUPLEX COIL SPRING

The coil spring here illustrated was devised by the writer for use under conditions where the longest possible movement of rod *A* was desired. The part *B* is a



Coil Spring designed for Long Stroke

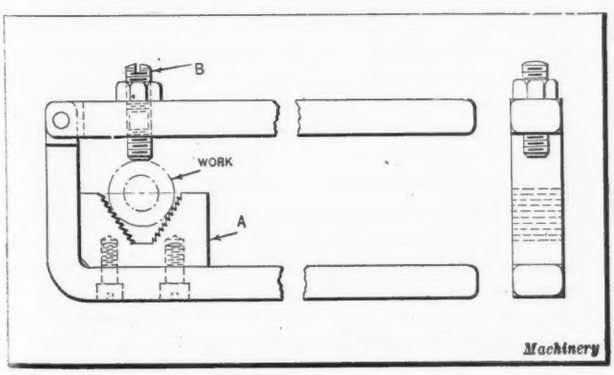
piece of steel tubing over which the outer spring *C* fits loosely, the end of the tube being spun over to form a flange having a diameter equal to that of the outside diameter of the larger spring. The opposite end of this tube is spun inward so that it retains the smaller spring *D* which slides easily within it. Rod *A* moves freely in the hole in the small end of the tube. The size of the springs and the diameter of the wire used should be such that about the same amount of pressure will be required to compress fully either the larger or the smaller spring. The writer has found this type to be more durable and longer-lived than a conical spring. It also exerts a more even pressure on rod *A*. A third and fourth spring could be added in the same manner if necessary.

Holbrook, Mass. FREDERIC W. BLANCHARD

ADJUSTABLE REAMING CLAMP

The clamp shown in the illustration was designed to hold small round collars while reaming out burrs produced in a tapping operation. As there were about a thousand pieces to be reamed daily, it was necessary that the clamp be so designed that it would have a firm grip on the work without the operator being required to exert much pressure on the handles of the clamp.

The angle of the vee in the clamping block *A* is 60 degrees. It will be noted that fine teeth are cut on the sides of the vee so that the clamping action is similar to that of an alligator wrench. With this type of V-block, only a very light pressure on the clamping handles is required. The V-block is the only part subjected to much wear, and it can be easily replaced when necessary. The operator can adjust the spread of the handles to suit his grip or for any size of stock by means of the set-screw *B*.



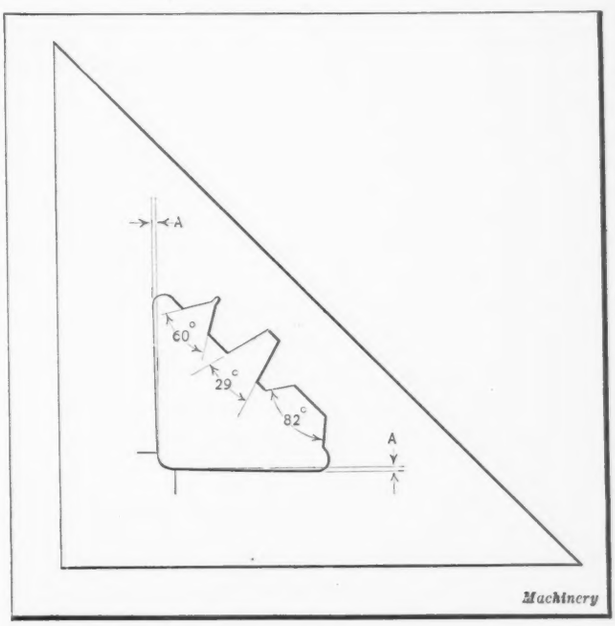
Clamp for holding Small Round Pieces of Work

Eastwood, N. Y. ELMER C. COOLEY

DRAFTSMAN'S TIME-SAVING TRIANGLE

A designer or draftsman frequently must draw taper pins, heads for countersunk screws, Acme standard screws, and standard screw threads. To draw these without the proper tools or instruments requires considerable time, and to have a tool for each purpose results in littering up the drawing-board. A 45-degree transparent triangle is invariably kept on the drawing-board, as it serves many purposes. This triangle can be made to include means for drawing all the previously mentioned details, if modified as shown in the illustration.

The 60-degree cut is for use in drawing U. S. standard threads, V-threads, and any 30-degree angle. The 29-degree



Triangle designed to save Time

cut is for drawing worms or Acme screw threads. The 82-degree cut is for drawing countersunk head machine screws, while the two slight tapers are for drawing pins having a taper of ¼ inch per foot. The angles *A* are, of course, made to a taper of ⅛ inch per foot in order to have the included angle correspond to the ¼-inch per foot taper. It will be noted that the guiding edges used in drawing taper pins are so located as to require only a 90-degree movement of the triangle to permit drawing both sides of the pin.

Takoma Park, D. C. G. W. NUSBAUM

* * *

The largest alternating-current motor for steel mill use ever made in this country is being designed by the General Electric Co. for use at the River Rouge plant of the Ford Co., at Detroit, Mich. This motor will develop 8000 horsepower with a speed of 240 revolutions per minute. It will be used to drive a large blooming mill at the River Rouge plant, where installations are now being made to manufacture steel.

Questions and Answers

PROBLEM IN GAGE DESIGN

B. A. H.—In designing the gage shown in Fig. 1 a mathematical problem is involved in determining the distance x, which gives the location of the line of intersection of the

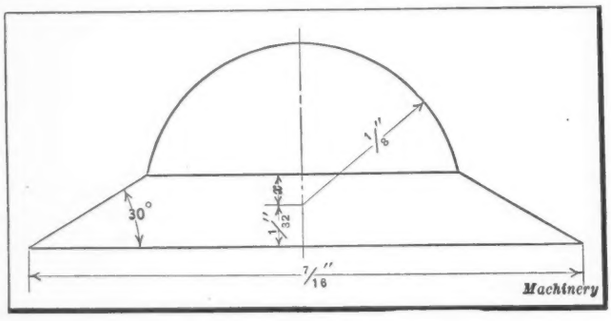


Fig. 1. Gage having Spherical Surface involving Mathematical Calculations

spherical and conical surfaces. How can distance x be found?

ANSWERED BY GUSTAF E. NORDSTROM, WORCESTER, MASS.

In the following is presented a solution to the problem in gage design which appeared on page 730 of May MACHINERY. The present solution does not involve the angles D, E, and X, as shown in Fig. 2.

Referring to Fig. 2, we have

$$AM = \sqrt{3}(a + x)$$

Now by geometry,

$$r^2 = x^2 + [b - \sqrt{3}\,(a + x]^2$$

$$= 4x^2 - 2x\,(b\sqrt{3} - 3a) + (b - a\sqrt{3})^2$$

Substituting the known values in this equation, we have

$$\left(\frac{1}{8}\right)^2 = 4x^2 - 2x\left(\frac{7\sqrt{3}}{32} - \frac{3}{32}\right) + \left(\frac{7}{32} - \frac{\sqrt{3}}{32}\right)^2$$

Simplifying and uniting terms we have,

$$4x^2 - 0.5703x = -0.01148$$

and

$$x = \frac{0.5703 \pm \sqrt{0.5703^2 - 16 \times 0.01148}}{8} = 0.0243 \text{ inch}$$

ANSWERED BY MICHAEL A. HICKEY, ROCHESTER, N. Y.

The problem in gage design presented in May MACHINERY may be solved in the following manner:

In Fig. 3, angle $CAF = 30$ degrees, and the perpendicular CF dropped from C to $AG = 1/32$ inch. Therefore,

$$AF = \cot 30 \text{ degrees} \times 1/32 = 0.05413$$

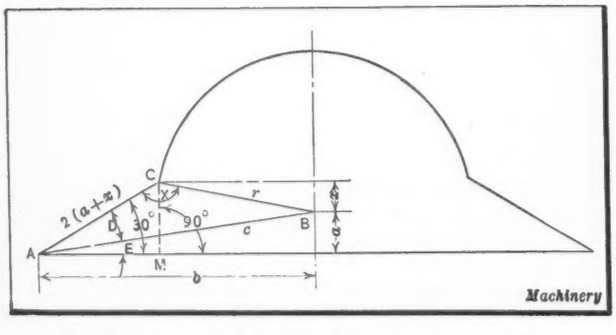


Fig. 2. Diagram used in the Solution of the Gage Problem

Also

$$FG = AG - AF = 0.16462$$

It is evident from the illustration that

$$CO = FG = 0.16462$$

Next a perpendicular is dropped from point D to line CO. In triangle DCE we have $CE = \cot 30 \text{ deg.} \times x = 1.73205x$ Now

$$EO = \sqrt{DO^2 - DE^2} = \sqrt{0.125^2 - x^2}$$

It is clear from the illustration that

$$CE + EO = CO$$

Substituting numerical values in this equation, we have

$$1.73205x + \sqrt{0.125^2 - x^2} = 0.16462$$

Simplifying and uniting terms we have,

$$4x^2 - 0.57026x + 0.01147 = 0$$

or

$$x^2 - 0.14257x + 0.00287 = 0$$

Adding 0.00221 to both sides of the equation to complete the square we have

$$x^2 - 0.14257x + 0.00508 = 0.00221$$

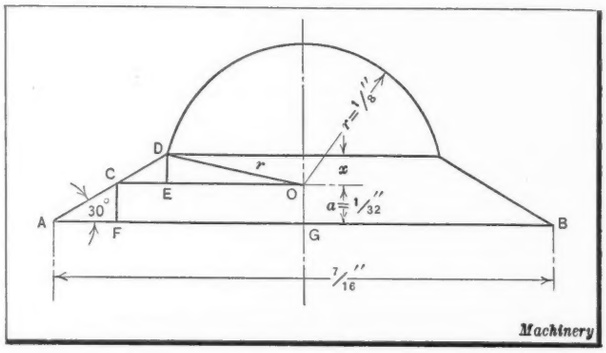


Fig. 3. Diagram used in Another Solution of the Gage Problem

Solving for x we have,

$$x - 0.07129 = \sqrt{0.00221}$$

and

$$x = 0.02428 \text{ inch}$$

APPLYING FOR A DESIGN PATENT

G. S. P.—I wish to make an application for a design patent, and would appreciate your informing me as to the length of time for which design patents are granted and the fees charged by the Government for filing and issuing design patents.

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

Design patents are granted for three and one-half years, seven years, and fourteen years, as the applicant may elect in his application, after payment of the fee required by law and an examination as to its novelty. If the application is originally for one of the shorter terms, the applicant at any time before the allowance of the application and upon payment of the additional fee, may amend his application and request that the patent be issued for a longer term. The procedure in applying for design patents is substantially the same as in applying for other patents. The Government fee is $10 for the three and one half year period. $15 for the seven-year period, and $30 for the fourteen-year term.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, July 16

THE general feeling in the metal-working industries is that conditions are improving steadily, if slowly. The trend of the unemployment figures points in this direction, but beyond this, definite and unmistakable signs of increasing activity are few and far between. Machine tool builders are plodding along steadily; several shops in the Midlands have a fair amount of both standard and special work in hand, and in this area, the special machinery demand keeps designing and patternmaking departments busy.

The activity in inquiries that has been such a constant feature throughout the barren period of many months past is unabated. There are still many machines of the general-purpose class that are held by dealers who purchased them at almost scrap prices a year or more ago at government auction sales, and the present owners can afford to hold their purchases until they get definite inquiries for the particular class of machines they have in stock. Although the number of machine tools of this type is not large, compared with the numerous obsolete and generally useless special machines sold from government stock, the number is sufficient to make itself felt in the present strong competition. The inquiries reported from nearly all the machine tool areas point undeniably to a wide need for new equipment, and a small general trade improvement will probably prove a sufficient stimulus to induce would-be purchasers to buy on a much heavier scale. The inquiries are not confined to the home market; India is prominent, and South Africa, after a period of quietness, is beginning to show an interest in new machines.

There is a fair proportion of work in the shops on behalf of Colonial railways, but new orders for this class of machine tools are not now so easily obtained as was the case a few months ago. A good demand, however, is expected from South America, where the prices to which American machine tools have recently been advanced is a factor that favors the British machine tool builder, who has to some extent reached stabilization in labor costs. In Victoria and New South Wales, great promise is held for British machine tools, and these districts are generally thought to be on the eve of a trade boom. The Commonwealth government imposes high import duties to protect its own industries, and although machine tools are not yet made to any extent in that country, their manufacture will no doubt be taken up as the demand increases.

The Iron and Steel Industry

The iron and steel industries are not making the progress that was expected, and both home and export demand has dwindled. There are, however, very small stocks in most markets and any general improvement will be reflected at once. Although for the month of May the export figures in the iron and steel industries were an improvement on anything since pre-war times, the average for the first six months of the year is not good, and the June exports showed a considerable falling off from those of May. The uncertainty of the results that are to be reached in the Ruhr no doubt has a strong effect on the iron and steel field, and until some tangible settlement has been arrived at, commercial confidence cannot be expected. Continental makers are offering cheap iron and steel in British markets, and several small buyers are now filling their wants from Belgian blast furnaces and steel mills.

Midland foundries are fairly well employed in both iron and malleable castings, but moderate stocks of raw materials were purchased by these manufacturers before the general rise in prices, and this activity has not yet been felt in the pig iron market. In the Sheffield open-hearth steel branches, a rapid tapering off of new business is shown. This section of the steel industry has had a very good business during the last six months, but the general opinion on the situation is that prices will have to recede again to the low level ruling some months ago, in order to revive the interest of buyers and insure the placing of long-time contracts. The crucible and other steel trades continue to be depressed by the further offer of large government surplus stocks at very low figures. In the light manufacturing industries, the position is much brighter; stampers and press workers in the Midland district are fairly well employed, and a few firms in the industry are working over-time.

Railways and Shipbuilding

In Sheffield, railway axles, springs, tires, and wheels are in great demand for Australia, Egypt, India and South America, and there is a fair production of these articles for home railways. One Birmingham firm has obtained an order for 500 cars for the Indian railways and a further order of 100 cars for South Africa. Although not large, it is expected that these orders will prove the forerunners of much heavier business, as these countries have many new lines under construction and rolling stock will be needed in proportion.

On the Clyde, shipbuilding is in a decidedly unprosperous state, and this has a serious reflex effect on the many allied trades in the Glasgow area. The boilermakers' strike is having an adverse effect, and there are reports on all hands of the suspension of shipbuilding orders. How work in the yards is being affected by the lock-out may be seen from the May statistics of tonnage launched. The Clyde total consisted of ten vessels of only 17,210 tons, which was much lower than that of any previous month this year, and the lowest for April since 1908. There are no new prospects of an agreement over the boilermakers' trouble, but the men are to reballot on the question. It is not generally expected that shipbuilding can revive before the fall.

The General Engineering Industries

Depression hangs over the gas and oil engine industry, and the absence of orders from Russia and the Near East is seriously felt.

The activity in the automobile industry continues, the interest in light cars being unabated. One well-known maker of the latter class, although producing a record weekly output, disposes of his product to waiting buyers. The present year has restored a considerable amount of confidence in the industry. There is already a substantial and steady inquiry for next year's output, and big-scale developments in production are promised.

Makers of motorcycle engines are very busy, and the export trade is active in this branch of the industry; Australia, in particular, is buying freely, while Japan is buying on an increasing scale. Exports to the latter country are expected to increase rapidly when present Japanese plans for motorcycle building from imported parts have been completed. In the small tool industry, there is very little change. Most works are well employed.

HOLDERS FOR SQUARE TOOL BITS

By MARTIN H. BALL

Single-piece forged tools are used in some instances only because it is believed that tool bits held in a standard type of holder would not be rigid enough. One of the advantages gained by using tool bits is that the heat-treatment given the bits by the maker generally results in better and more uniform tools than the varied heat-treatment given tools made from bar stock by the user. No claim is made that the rigidity of a tool bit held in the holders here illustrated and described is as great as that of a single-piece tool. However, it is believed that tool bits held in the holders here shown have much greater rigidity than those held in some types of holders now in common use.

At *A*, Fig. 1, is shown a tool bit held in a horizontal position with the holding pressure applied in a vertical direction. In this case the tool bit is seated in the groove with a clearance at each side. The side pressure exerted by the work on the bit will have a tendency to make the tool spring away from the work. This usually causes the tool bit to change its position in the holder until it has a bearing on the sides of the groove.

Although the difference between the width of the channel or groove in the holder and the width of the tool bit is purposely exaggerated in the view at *A*, there is necessarily some clearance in practically all equipment of this kind. When the holding pressure is applied by a set-screw which bears directly on the top of the tool bit, the latter will have a tendency to pivot at the point where the set-screw bears upon it until its sides are in contact with the sides of the groove. Under a light side pressure, such as results in taking a very fine cut, the tool bit will sometimes spring back and forth, thus producing chatter marks.

The conditions referred to in the preceding paragraph can be much improved by carefully setting the tool bit against the sides of the groove, preparatory to taking a cut. However, most operators cannot be depended upon to take such precautions. With the equipment here shown, the proper setting of the tool is automatically provided for by designing the holder so that the tool is clamped in place as shown at *B*. This principle is embodied in the planer tool shown in Fig. 2, and also in the boring-bar shown at *C*, Fig. 1, where the set-screw bears on the corner of the tool bit and forces it against the lower corner of the slot that is opposite the cutting side.

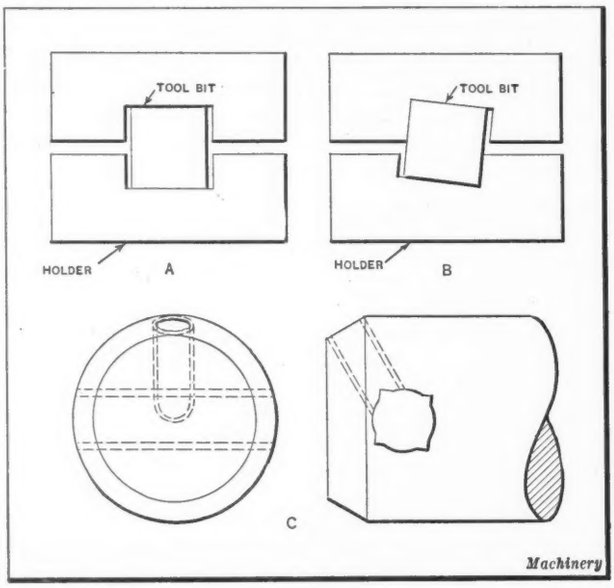


Fig. 1. Holders for Square Tool Bits

The end of the boring-bar shown in Fig. 1 is chamfered to facilitate drilling and tapping the set-screw hole. The accompanying table gives the drill and broach sizes that may be used in producing the holes in which square tool bits are to be held. Holes produced in accordance with this table afford bearing surfaces having a total area equivalent to about 50 per cent of the entire area of the hole. The bearing surfaces thus provided will not permit the tool bit to rock, even though its sides are slightly convex, as is often the case.

The planer tool when assembled as shown in Fig. 2, can be fed from the operator's side of the table. By reversing the position of the top and bottom washers *A* and *B*, the tool can be fed in the opposite direction. By swiveling the turret-head of the holder 60 degrees to one side, so that the tool will be in the position shown at *C*, and setting the

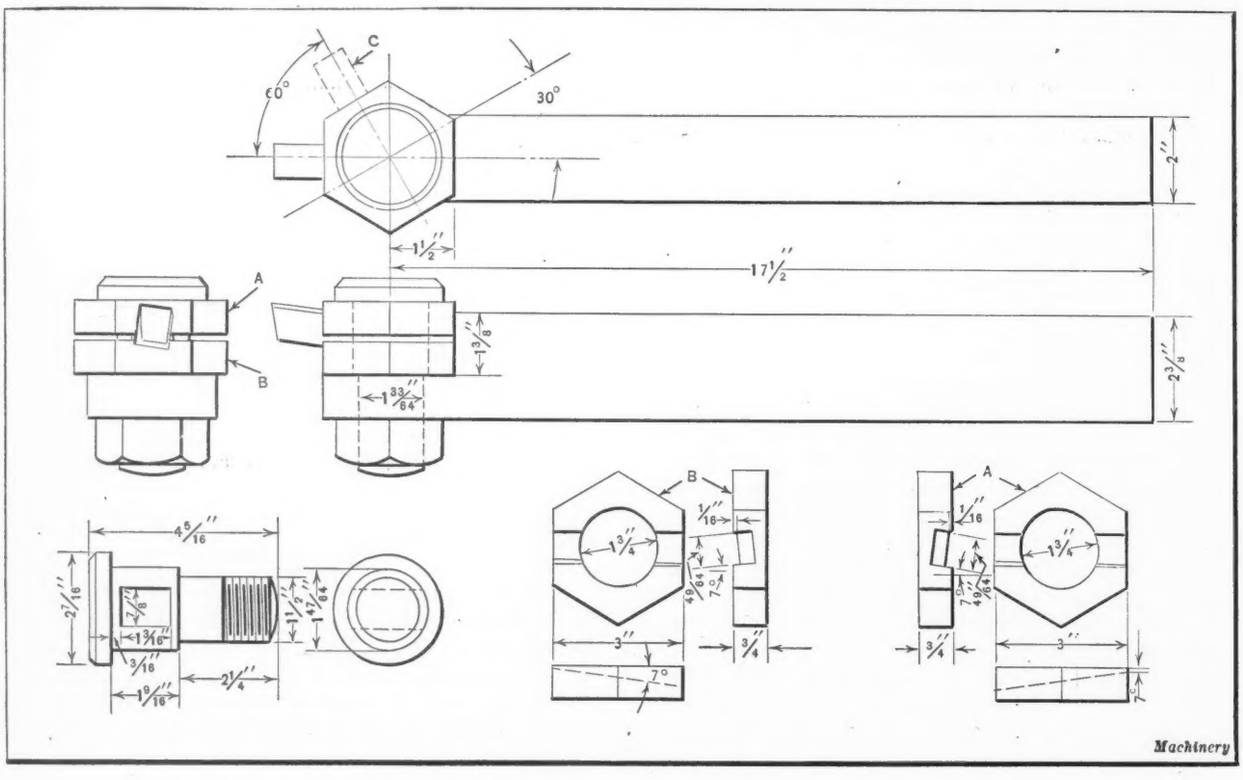


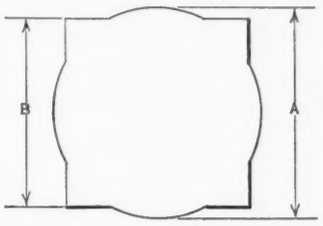
Fig. 2. Details and Assembly View of Square Tool Bit Holder for Use on Planer

clapper-box of the planer at an angle of 30 degrees, the tool bit will be in the proper position for a down feed, such as is obtainable with the regular cross-rail head.

When tool bits are held in the manner described, they are ground for side rake only This leaves the tool bit somewhat stronger than if it were ground down on two or more sides. For machining materials that require a tool with a negative top rake, the extreme edges of the tool bit may be flattened slightly like the lips of a twist drill that is to be used for drilling brass.

* * *

DRILL AND BROACH SIZES FOR SQUARE TOOL BIT HOLES



B Size of Broach, Inches	A Size of Drill, Inches	B Size of Broach, Inches	A Size of Drill, Inches
1	1 1/8	7/16	31/64
7/8	63/64	3/8	27/64
3/4	27/32	5/16	11/32
5/8	45/64	1/4	9/32
1/2	9/16	.....	.....

Machinery

FIXTURE AND CUTTER EQUIPMENT FOR MILLING A SPECIAL SLIDE

By S. A. McDONALD

There is a tendency on the part of many jig and fixture designers to overlook the ordinary milling machine vise in considering a method of holding a piece of work that is to be machined. As a result, jigs and fixtures of elaborate designs are often developed for work that could readily be held in the vise. This makes the cost of the tool equipment unnecessarily high. In designing the fixtures shown in the accompanying illustration, for machining the special slide *A*, an effort was made to combine quick-acting features with simple construction.

The slide, as originally designed, did not have the relief cut in the base, but at the tool designer's request, this refinement was added, as it did not affect the functioning of the slide and was of considerable assistance in providing a suitable means of locating the work in the second milling operation. All burrs or lumps were removed from the castings by hand-grinding previous to the machining operations. The first operation on the slides, that of machining the bottom surfaces *b*, proved to be one of those jobs for which the milling machine vise could be used with as good results as could have been obtained with any type of special fixture. The work was set up as shown at *B*, and milled by a set of plain milling cutters *c*.

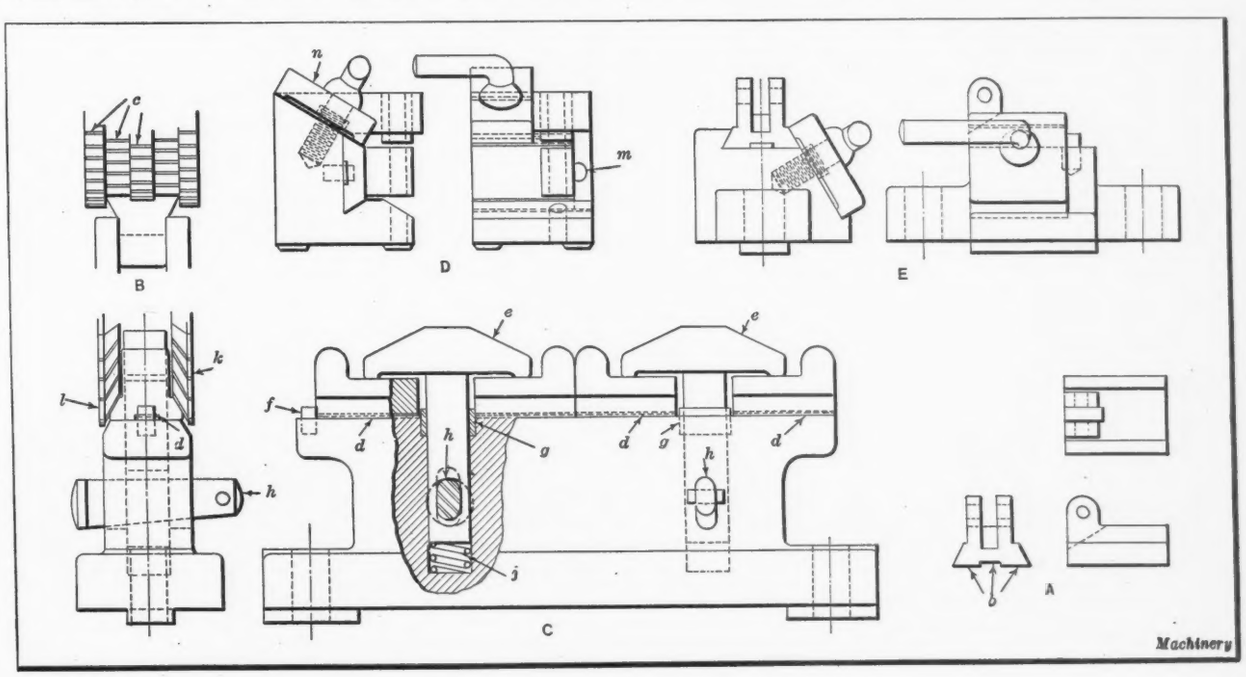
The fixture used for the second milling operation was designed to hold four pieces of work. The slides in this case were located on the fixture as shown in the view at *C*. Keys *d*, machined on the top of the fixture, serve to locate or align the work properly. The clamping bolts *e*, each hold two slides, while the pin *f* and the collars *g* take the thrust imparted to the work by the milling cutters. The wedges *h* are tightened or loosened by the tap of a hammer. The clamping bolts are nominally held up by springs *j* to facilitate loading or unloading the fixture. Right- and left-hand 60-degree milling cutters *k* and *l* are used to mill the sides of the slides.

The drill jig used for drilling the hole in the lugs is shown at *D*. The body of this jig was made from a block of cast iron, so that no pattern was necessary. The work is located by one side of the dovetail and a pin *m*. The clamp *n* is provided with a coil spring, which leaves it clear of the work when the latter is released. A quarter turn of the clamping bolt is all that is necessary to lock the work in place.

The fourth and last operation, that of milling the slots in the lug, is performed with the work held in the fixture shown at *E*. A slotting cutter is used for this operation, and a stop on the milling machine regulates the depth of the cut.

* * *

Cast-iron pipe that is centrifugally cast must be heat-treated, because the molten metal is chilled to some extent when it is thrown against the rapidly revolving water-cooled metal mold, and when the pipes are removed from the pipe-casting machine, they are brittle on the surface. Pipe cast in sand mold does not need this heat-treatment.



Equipment used in machining the Slide shown at A

The Machine-building Industries

GENERAL business conditions throughout the country remain normal, although it appears that the peak of the slight boom experienced in many industrial fields has been passed. In the machine tool industry there has been a slight decrease in demand, and the average percentage of unfilled orders is now higher than the percentage of new orders. Some manufacturers think that this is merely an indication of the usual falling off of business during the summer months; others believe that the peak apparently reached by other industries early in the spring was also reached by the machine tool industry at the same time, and that business in the fall will remain at about the present level.

One of the machine tool builders who is in close touch with the automobile industry states that there is a considerable amount of planning being done in this field, with a view to improving manufacturing methods for next year's production. "It is a well-known fact," says this manufacturer, "that a great deal of the equipment now being used in automobile plants is practically worn out, and will have to be replaced; and it is likely that there will be a fair demand for special machinery and for machines that will insure greater production." In spite of the great output of the automobile shops this year, competition has been very keen, and the manufacturers realize that low prices for cars, coupled with quality and reliability, are the prime requisites for continued good business.

The textile machinery manufacturers, as well as the electrical concerns, are well occupied, and a considerable amount of machine tool business has come from these industries. Although the general industrial demand fell off in June and early July, those machine tool builders that supplied the railroad trade have experienced a fairly active demand. Some orders of considerable proportions have either been placed, or are likely to be placed in the near future, by some of the larger railroads, especially in the West.

The foreign trade in machine tools is slowly improving, although it is very small, as compared with three and four years ago. The total exports of machine tools now amount to nearly $400,000 a month, while small tools are exported at the rate of about $250,000 a month, and other metal-working machinery at the rate of about $400,000 a month. In July, 1920, the machine tool exports were valued at about $1,850,000 and the exports of all other metal-working machinery at $1,823,000.

The small tool business continues at a normal rate, with a satisfactory volume of orders. Quick deliveries are generally required, indicating that the tools are going into direct use as fast as they are delivered and that buyers have no stocks of tools on hand.

The Automobile Industry

The automobile production during June did not fall greatly below the record set during May; it was the greatest production for the month of June that has ever been recorded. The figures for July will show the usual seasonal decline, but the industry is in a good position financially, and as there are no large supplies of surplus material on hand, and practically no stock of finished cars, the stronger companies, at least, look forward to the fall months with confidence.

The output of automobiles during the first six months of the year slightly exceeded 2,000,000 cars, of which 1,800,000 were passenger cars and somewhat over 200,000, trucks. The June production of passenger cars was 331,000, as compared with 350,000 in May, and 344,000 in April. The largest production of trucks during the year was in June—a total of 44,000—exceeding the May production by about 1000. The Ford company alone produced about 171,000 cars and trucks in June, and built 1,428,000 during the first six months of 1923. A new high production record for the Ford plants was made on June 30, when 6884 cars and trucks were completed. The Willys-Overland Co. has turned out its millionth car. The automobiles that have formerly passed the million mark are Ford, Buick, and Chevrolet.

Generally speaking, practically all plants have somewhat reduced their schedules, as compared with their peak production. Steel products for automobile parts are easier to obtain, and parts manufacturers have reduced their output to meet the lighter demand during the fall months. While there has been a falling off in the passenger car business, there has been an increased business in trucks. One of the largest concerns in the field states that sales are in excess of production, and the one difficulty is to fill orders on time. The sales of Pierce-Arrow trucks during the first five months of this year have been more than double those for the same period in 1922. The railroads are becoming an important factor in truck demand, as some of the roads are buying trucks for terminal work to be used in place of shuttle trains. There is a healthy demand for the smaller sizes of tractors, and the two largest producers are setting new records for production.

The Iron and Steel Industry

A slight decline has taken place in the unprecedented production of the iron and steel industry. The pig iron production in June was about 6 per cent less than in the record month of May. The production of steel in the early part of July showed little change, with the industry in general working at about 89 per cent capacity and the U. S. Steel Corporation continuing at 92 per cent. There is a sufficient stock of iron and steel for the country's needs, and recent price reductions indicate that more iron and steel has been produced than the country has actually consumed. While the industry absorbed the large output during the spring months as soon as it was produced, all of this material has not been used up yet in the shops of the buyers, and at present, shipments are considerably in excess of the new business booked.

On the other hand, the demand for iron and steel is more diversified, and the decline in prices has had the effect of inviting business that would otherwise have hesitated. The railroad buying of steel rails is keeping up, but the slump in the building industry is reducing the demand for structural steel. Buyers of pig iron are cautious, as some of them expect still lower prices.

The main facts in this basic industry are that buying is more conservative, that prices tend downward, and that new orders are less than shipments, which will bring about a more normal situation, permit earlier deliveries, and check the tendency toward high premiums paid for quick deliveries. A very favorable sign in the present situation is that there have been practically no requests for cancellations or for deferred deliveries, which indicates that buying has been done on a conservative scale and the material is actually needed in present production.

The Federal Reserve Bank, in summarizing its reports on the general industrial situation, finds that there is an evident determination on the part of business to watch for the earmarks of unhealthy expansion, and a preference for a normal level of activity. Business, therefore, is now moving forward carefully, watching the road ahead.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Hall Planetary Thread Milling Machine

A THREAD milling machine in which the work is held entirely stationary for cutting both external and internal straight or taper threads is built by the Hall Planetary Thread Milling Machine Co., Inc., Bridesburg, Philadelphia, Pa. The distinguishing feature of this machine is that while the milling cutter revolves on its own axis, it also travels in an orbit relative to the work. In cutting external threads, the cutter completely surrounds the work, as shown diagrammatically at *A*, Fig. 2, and in cutting internal threads, the cutter revolves within the work, as shown at *B*. This planetary feature is said to considerably reduce the time necessary for reloading the work. Cutters without lead are employed, lead being given to the thread by feeding the cutter longitudinally along the work while the cutter is revolving around it.

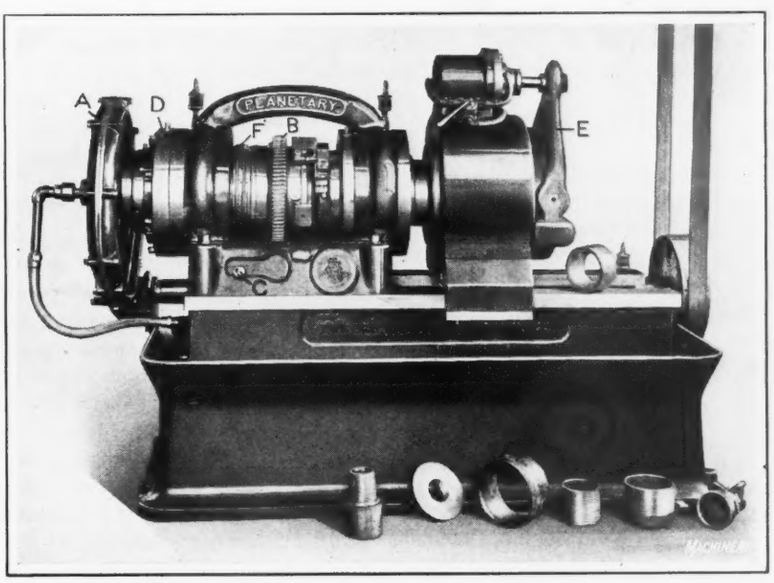


Fig. 1. Hall Planetary Thread Milling Machine in which the Work is entirely Stationary

This machine is intended for quantity production use, and is especially adapted for producing threads on a number of automobile parts, such as rear differential housings, and nuts, couplings, nipples, etc. Although a single-head machine is shown in Fig. 1, a double-head style is also built for cutting threads simultaneously on opposite ends of parts. The various types are built in several sizes, and may be automatic or semi-automatic in operation. There is also a portable style. The particular machine illustrated in Fig. 1 has a capacity for work ranging from ¾ to 18 inches in diameter.

The machine consists primarily of three units—the bed, head, and chuck, and each of these is generously proportioned so as to hold the cutter firmly against the work during the operation and permit high cutting speeds. Threads can be milled within plus or minus limits of 0.001 inch, and the portion to be milled need not be machined to the exact diameter, but only roughly, leaving a small amount of metal to be finished smoothly by the thread milling cutter. Power is delivered to the machine through the single pulley at the right-hand end, which may be driven from a countershaft lineshaft, or a motor on a base at the rear of the bed. For motor drive, a motor of 5 horsepower is recommended. The pulley shaft runs the length of the bed, and at the head end carries a sprocket which, through a silent chain, drives a large sprocket in casing *A*. The large sprocket is keyed to the cutter-spindle, which is hollow. The spindle speed is such as to give an average cutter speed of 100 feet per minute.

Planetary rotation of the cutter-spindle relative to the axis of the work is accomplished by means of two hollow eccentric containers or sleeves, one within the other. The spindle is journaled in bearings in the inner one. When work is being reloaded, the cutter-spindle simply revolves on its own axis, which is in line with that of the work, and the containers remain stationary, but in cutting the thread, the two containers are revolved as one unit to give the planetary movement to the cutter. The diameter of the orbit about which the work revolves, which controls the depth of the cut, depends upon the distance between the axes of the two containers, which is readily adjustable. The bearings of the head in which the outer container revolves are of a collet type, and are conveniently adjustable to compensate for wear.

The complete thread is cut in the work in one and a fraction revolutions of the containers, which are driven through the bronze worm-wheel *B*, mounted on the outer container. At the beginning of the worm-wheel rotation the cutter is fed to depth, and it moves around the work for an entire revolution to complete the thread, at which time the drive to the containers is reversed, to return them to their original positions. The forward and reverse rotation of the containers is controlled by means of stops.

Worm-gear *B* is driven by a worm which receives power from reduction gearing contained in an enclosed gear-case at the rear of the machine, which is kept filled with oil. The drive is transmitted to this reduction gearing from the pulley shaft by a pair of spiral gears. Power is delivered to the containers when knob *C* is pulled forward to operate a clutch. The containers then rotate in one direction until the thread has been completed, at which time the clutch is automatically tripped and a second clutch is engaged to drive them in the reverse direction, as previously mentioned. When the containers have been returned to the starting position, the second clutch is also disengaged automatically. The reverse rotation is accomplished at about ten times the forward speed. A brake is provided for the containers at *F*.

The containers and hollow spindle are fed longitudinally during a threading operation by means of a threaded master ring mounted on the outer container, which engages master nuts attached to the head at *D*. The master ring and nuts are necessarily different for each different thread lead,

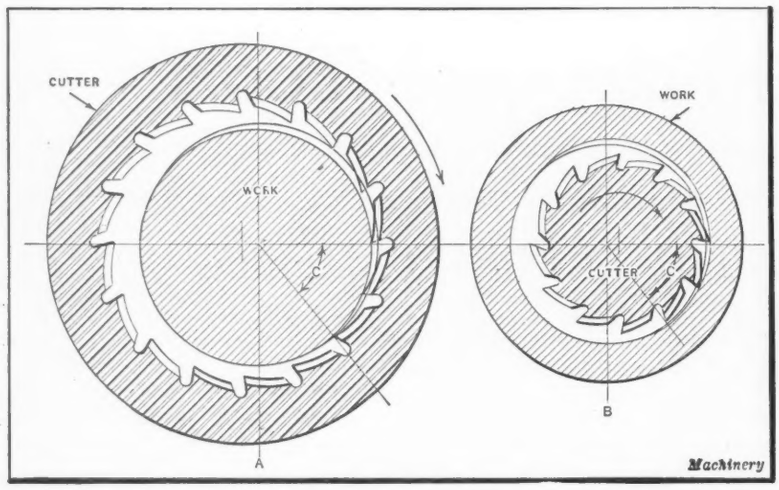


Fig. 2. Diagrams which show Relation of Both External and Internal Cutters to Work

but as the machine is intended for production work, changing of the ring and nuts would seldom be required. The cutting of taper threads is made possible by means of a device which causes the cutter to be fed radially the necessary amount during its planetary rotation around the work. Lubricant is supplied to the cutter through the hollow spindle from a pump in the base, which can deliver up to 40 gallons of lubricant per minute. The pump is driven direct from the driving shaft, and delivers the lubricant to the left-hand end of the spindle through a pipe. The base of the machine serves as a reservoir for the lubricant.

For firmly holding the work during threading operations, there has been provided an amply proportioned pneumatic chuck which weighs 3000 pounds, and has a gripping power of approximately 30,000 pounds, with an air pressure of 100 pounds per square inch. The chuck is of the push-in collet type, the split sections being brought in contact with the work at a uniform pressure when air is supplied to the cylinder to swing yoke *E* and force the collet-controlling member forward. The chuck shown in the illustration is used for holding oil-well tool joints. Chucks of different designs are used for other classes of work. After the chuck has been positioned for a given job, it is bolted to the bed and not disturbed until the class of work is changed. Thus neither the head nor the chuck has a longitudinal movement during an operation, and the work does not rotate.

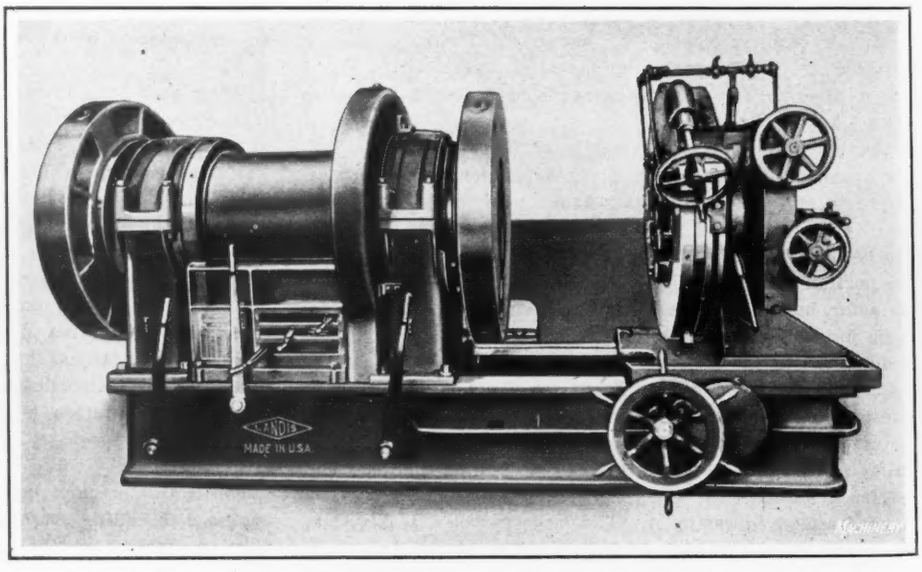
Cutters for producing external threads are about 20 per cent larger in diameter than the work, and are equipped with chaser blades so that they resemble a die-head. Instead of the cutting edges of both the external and the internal cutters being ground radially, they are given a generous rake. The planetary rotation of the cutters results in an unusually large sweep of the cutting edges, as indicated by angle *C* in Fig. 2. There are always two or more edges in contact with the work at the same time. Where a cutting edge begins contacting with the work, a finishing cut is taken, and where it leave it, a roughing cut is taken, the result being that a fine smooth finish is obtained on the threads. Ring-oiled bearings are provided throughout the machine, and all gears are made of steel or bronze. The weight of the machine illustrated is approximately 13,000 pounds.

LANDIS PIPE THREADING AND CUTTING MACHINE

A machine that handles pipe from 8 to 18 inches in size has been added to the line of pipe threading and cutting machines built by the Landis Machine Co., Waynesboro, Pa. In many respects this machine is similar to the 12-inch size described in March, 1922, MACHINERY. The entire range of the machine is covered by one die-head and one set of chasers. It has a single-pulley drive, eight variations in speed being obtained by means of a speed-box located beneath the main spindle. When driven by motor, a chain sprocket is substituted for the driving pulley, and the motor is mounted on a base placed over the gear-box. A friction clutch is mounted on the main driving shaft with the pulley for controlling the operation of the machine. The operating cone of the clutch is moved by either of two levers which are located at the ends of the headstock within easy reach of the operator. The forward lever is used for starting and stopping the machine when threading pipe, and the lever at the rear for starting and stopping when machining flanges. The lever at the middle of the headstock is manipulated for reversing the operation of the machine.

All gears are fully enclosed, and with the exception of the main driving gear and its pinion, run in an oil bath. The main bearings of the hollow spindle are lubricated by means of flat-link chains which carry oil from large reservoirs in the base. The driving pinion shaft and the reverse shafts are lubricated by sight-feed oilers. At each end of the hollow spindle there is a three-jaw independent chuck for holding the pipe during the operation. The rear chuck is equipped with grips for holding flanges.

The carriage that supports the die-head and the cutting-off and reaming tools is moved either by power or by hand. The power movement is both forward and backward, and is controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the right-hand chuck, the lever is pulled and held until the threading position of the die is reached. Automatic stops prevent the die-head from coming in contact with the chuck in the forward movement, and prevent the carriage from running off the guides of the bed in the backward movement. The reaming tool is quickly set in position and locked by means of a



Landis Pipe Threading and Cutting Machine

lever. This machine employs the Landis "long-life tangential chaser." The length of the machine is 12 feet 2 inches, and its height is 6 feet. The extreme width of the belt-driven machine over the belt pulley is 5 feet 10 inches, and of the motor-driven machine over the motor plate, 6 feet 8 inches. It weighs about 22,000 pounds.

CRESCENT METAL PARTS WASHING MACHINES

Two improved automatic machines of the type illustrated in Fig. 1 for washing metal parts are being introduced to the trade by the Crescent Washing Machine Co., 83 Second Ave., New Rochelle, N. Y. These machines are the same in all respects except size, the model 1A receiving parts up to 18 inches wide by 14 inches high, and the model 2A, parts up to 26 inches wide by 14 inches high. Smaller pieces are placed on the conveyor in racks. The model 1A is a high-speed machine particularly fitted for installation in small metal-cleaning departments at the end of a line of automatic screw machines or in other locations where floor space is limited. The model 2A is best suited to meet the needs of the average metal-parts cleaning department.

The main improvements in these machines as compared with the older types built by this company, are that the wash tank has been increased in size to give added capacity for the cleaning solution, and that cleaning-out doors are now furnished so as to make it an easy matter to clean both the upper and the lower part of the machine. The motor and pump are both mounted on the outside where they are readily accessible. The conveyor unit has also been simplified by using a completely enclosed set of gear-reducers instead of the original system of chain reducers. By making minor changes in the shape of the wash arms and in their location, the machine has been made faster and more thorough in operation. The weight of the model 1A equipment is approximately 2250 pounds, and the model 2A machine weighs 2550 pounds.

Composite type machines are also built in various lengths for a number of purposes. One of these machines in use in an automobile plant for cleaning fenders prior to enameling is illustrated in Fig. 2. This is considered a particularly difficult job, because the fender surfaces must be thoroughly clean if the enamel is to hold without pitting or stripping. The fenders are placed on the conveyor at one end and carried through the machine at a speed of about 20 feet per minute. They are washed, rinsed, and delivered at the opposite end. In addition to washing and rinsing the parts, these machines may also be used for drying, lacquering, and slushing.

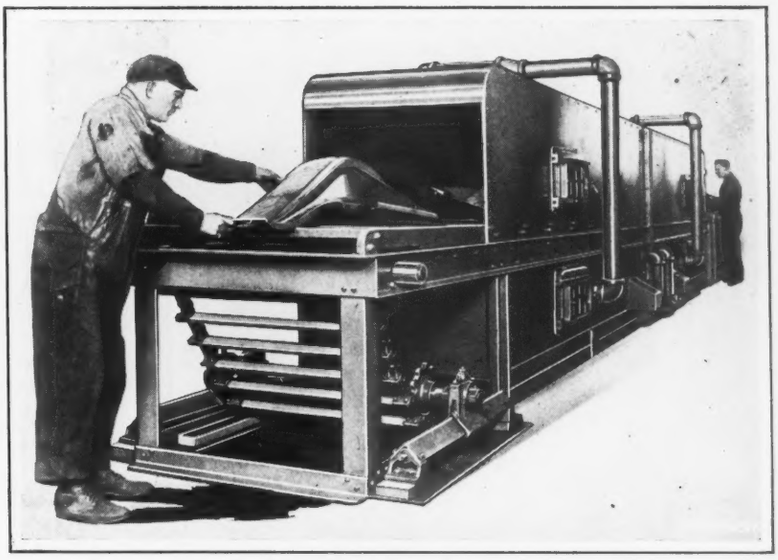


Fig. 2. Composite-type Machine used to clean Automobile Fenders

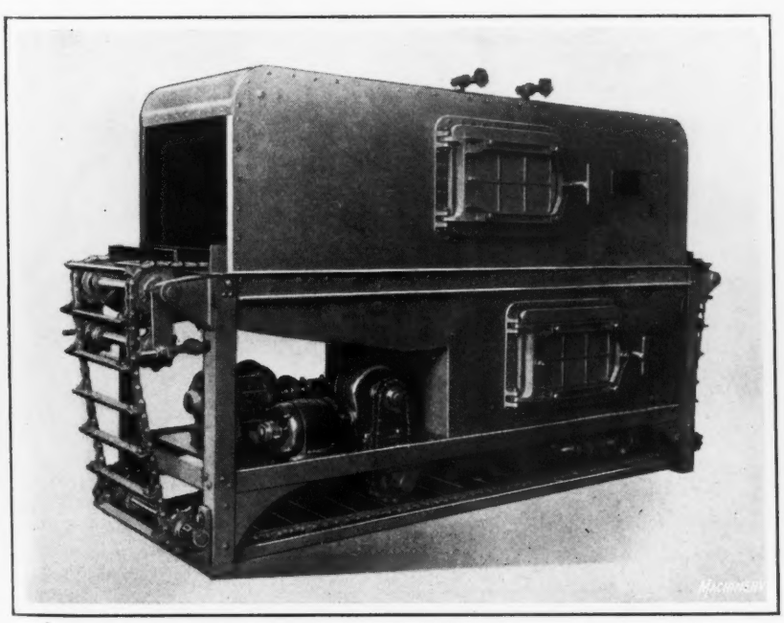
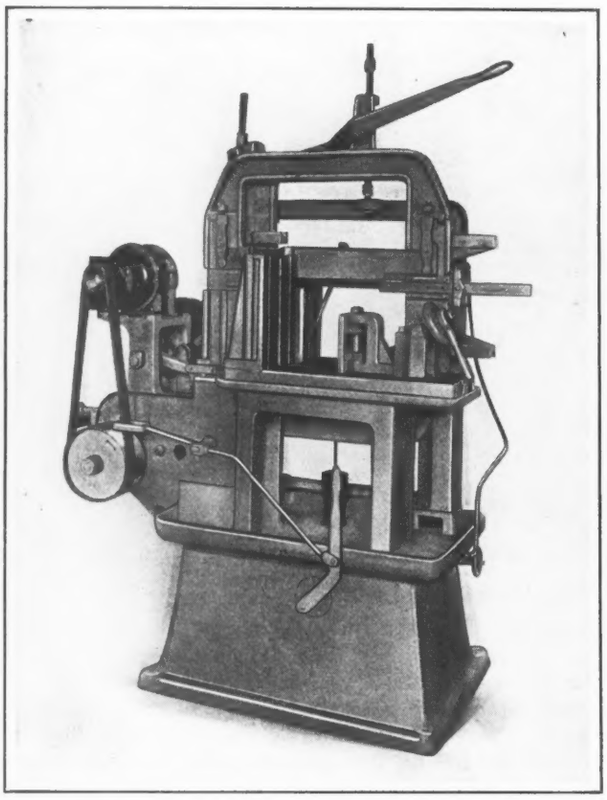


Fig. 1. Crescent Automatic Washing Machine for Metal Parts

PEERLESS UNIVERSAL SHAPING SAW

A 13- by 13-inch universal shaping saw similar in construction to the smaller machine described in March, 1922, MACHINERY is being placed on the market by the Peerless Machine Co., 1611 Racine St., Racine, Wis. The new machine embodies several features that the smaller machine did not have. The frame accommodates blades from 14 to 21 inches long, and as before, the blade-clamping apparatus is designed to permit a 10,000-pound tension in the blade. In addition to provision for holding the blade rigid and straight under this tension, a thrust plate has been added above the blade to take the upward thrust, and hold the blade tooth points in a straight line so that all the teeth will do the same amount of work. The thrust plate is 4 inches wide and 0.048 inch thick which corresponds closely to the thickness of No. 18 gage saw blade stock. The plate is made of blade steel, and is also placed under tension by the use of two clamping straps. Two set-screws permit fine vertical adjustments to bring the plate to the blade for careful alignment.

Another improvement intended to cut down the handling time is a dual-control feed mechanism. In engaging the feed, the operator uses his right hand to manipulate a lever on the right-hand side of the machine, and with his left hand, lowers the blade and frame to the approximate cutting position just prior to engaging the feed. The left-hand side of the machine is also equipped with a feed-lever, so that the machine can be started from either side. The belt-shifting mechanism is connected to the starting lever on the left-hand side, so that in one motion the belt is shifted on the tight pulley to put the saw frame in motion and also engage the feed. This arrangement is said to considerably reduce the time taken in resetting stock for a new cut, and also saves time



Peerless Universal Shaping Saw of Larger Size and Improved Design

when the operator stops the machine to see how near a line the cut is going to be.

A rod for automatically stopping the saw at the completion of a cut or at a predetermined depth of cut is part of the saw-frame mechanism, and depth and height gages are also provided. The height gage is brought down after a cut just sufficiently to permit the blade to clear the work. The releasing of the feed, the upward return of the saw frame, the stopping of the frame, and the preliminary approach to the new cut are all automatically controlled. Special fixtures can be provided for holding forgings in sawing the ends to length, and for similar work. Stroke speeds of 125, 80, and 45 per minute are obtainable. The saw frame, which is located on the right-hand side of the arch in the 6-inch machine, is located on the left-hand side of the new machine. This design brings the reciprocating member inside the machine for safety, and makes the work more readily accessible. Long structural steel beams and pipes can be clamped at an angle without interference from the arch. The weight of this machine is about 2200 pounds.

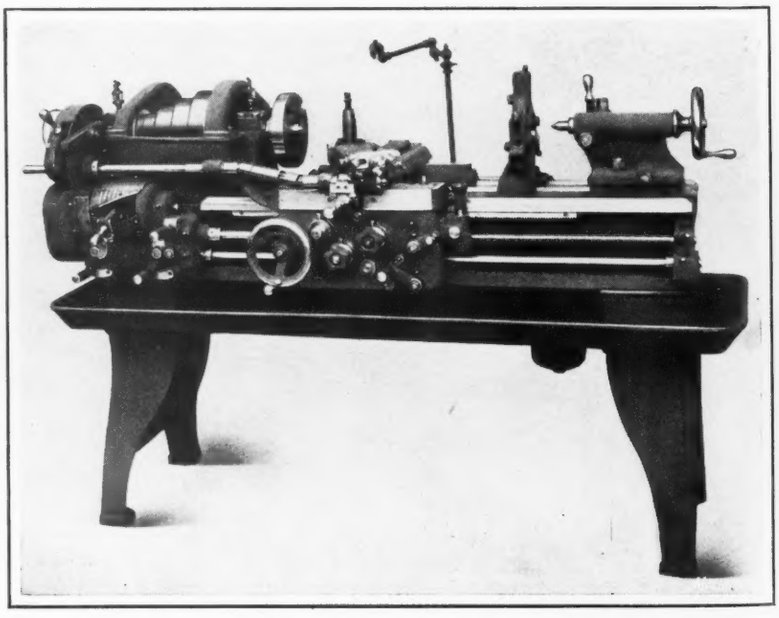
AMERICAN TOOL-ROOM LATHE

A tool-room lathe built by the American Tool Works Co., Cincinnati, Ohio, in six sizes, from 12- to 24-inch swing, inclusive, is shown in the accompanying illustration. Except for the taper, relieving, and draw-in attachments, this machine is of the same construction as the lathe described in June MACHINERY. Up to and including the 18-inch size, the machine is regularly equipped with a single back-geared head having a four-step cone, while on the larger sizes a double back-geared head provided with a three-step cone is furnished. In addition, the following heads can be supplied: A three-step cone friction double back-geared head; a twelve-speed geared head with single-pulley drive; a twelve-speed geared head arranged for either a geared or belted constant-speed motor drive; and a four-speed geared head for either a geared or belted variable-speed motor drive.

The taper attachment can be changed to suit taper or straight work by simply loosening one bolt and tightening another. There is a rigid connection between the tool-rest and the sliding shoe, which lessens the load on the cross-feed screw, and prevents any looseness or backlash in the screw, nut, or journal from being transmitted to the work. The use of a dovetail type of taper bar and a sliding shoe equipped with a taper gib adjustment also obviates inaccuracy due to looseness, and prevents lifting tendency under heavy cuts.

The relieving attachment is built in two types—plain and universal. The plain attachment is designed for external and internal cylindrical work only, while the universal attachment is intended for relieving or backing off the flutes of rotary cutters, taps, reamers, end-mills, hollow mills, dies, etc. End and internal relieving can also be performed. The change-gear mechanism of the attachment is supported by a bracket located at the front of the headstock, on top of the quick-change gear-box. A small quadrant carries the change-gears, and this is used to disengage the drive when the attachment is not required. Power is taken from a spur gear located on the spindle, and is transmitted through the change-gear mechanism to the driving shaft of the attachment, which is journaled in the supporting bracket on the gear-box and in a bracket fastened to the left-hand side of the carriage. Between the latter bracket and the tool-rest are located knuckle joints which permit cross movements of the tool-slide.

The driving shaft revolves in one direction until the spindle rotation is reversed, at which time the driving shaft ceases to reciprocate the tool-slide. With this arrangement, the tool-slide remains stationary when the direction of the carriage travel is reversed, and the tool can be withdrawn from the work and run back for a new cut, as is the practice in tap and hob making, without any waste motion of the parts and with safety to the cams. There is a clutch connection between the cam and the drive which is operative in only one direction, and therefore a reversal of the driving shaft causes the clutch, which is held in engagement by means of a spring, to be withdrawn from the cam. The result is that the cam remains stationary and imparts no motion to the tool-slide. In order to obtain the entire range



American Tool-room Lathe which is built in Six Sizes from 12- to 24-inch Swing, Inclusive

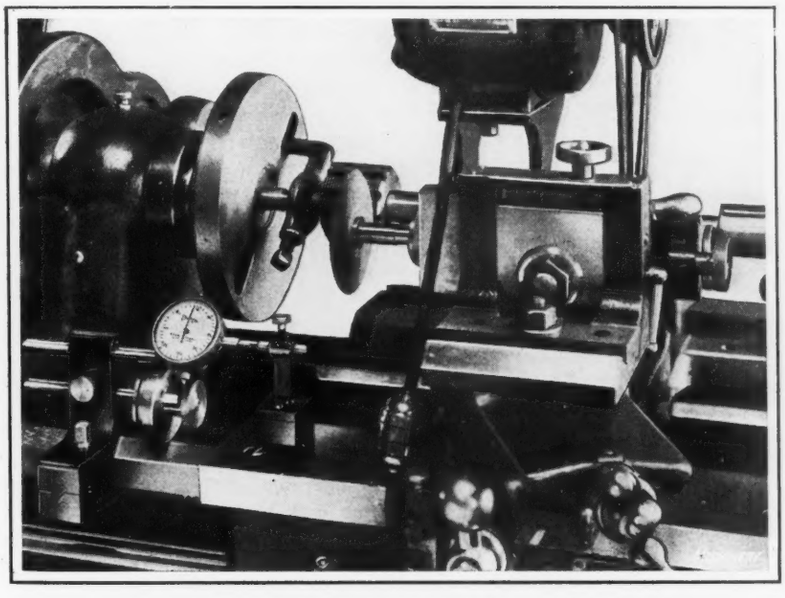
shown on the index-plate, three cams of one, two, and four lobes, respectively, are provided, in addition to the change-gears. This attachment permits of operating the tool-slide every 30 degrees, and thus provides twelve operating positions within a circle.

The plain relieving attachment consists primarily of a top and bottom slide and an intermediate nut lock controlled by a cam on the driving shaft. The draw-in attachment consists of a long, hollow steel bar, a hardened and ground steel taper bushing, and collets for holding different diameters of work. Collets are furnished for stock up to ⅞ inch in diameter on the small sizes, and up to 1 inch on the large sizes.

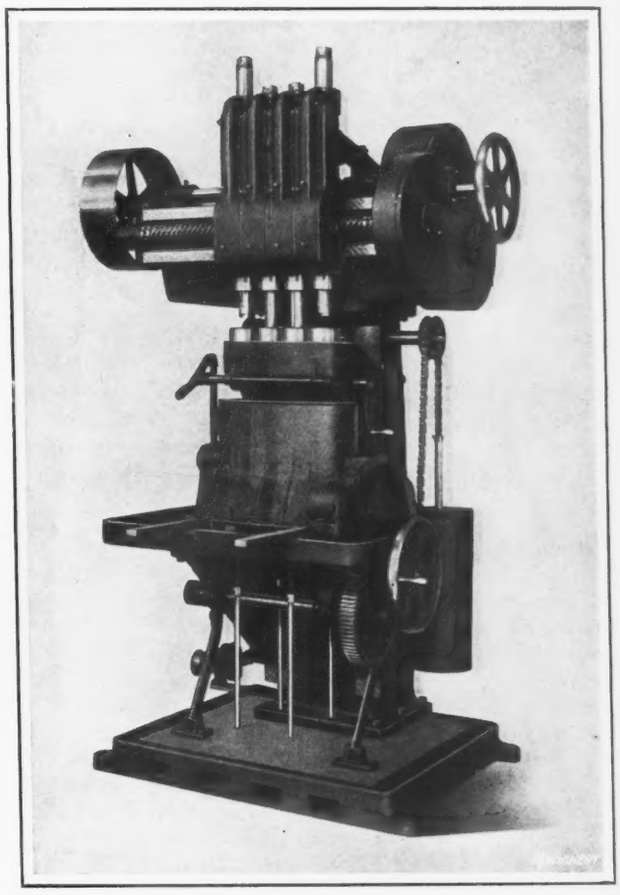
FRICK SPACING INDICATOR

A spacing indicator which is especially designed for use in grinding "no-lead" hobs, but which also facilitates boring shouldered holes by affording a means of accurately measuring the different depths, has been brought out by the Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. The instrument consists of a cast-iron base, a clamp for attaching the base to the ways of a lathe bed, a fine-pitch screw, a micrometer dial graduated to 0.0001 inch around its periphery, an indicator dial, and a stop-pin and bracket for mounting on the lathe carriage. The micrometer dial may be used to rotate the fine-pitch screw, but by loosening the thumb-screw, the dial may be revolved freely on the screw. When the screw is revolved, the rod that supports the dial indicator is moved in or out, depending upon the direction in which the dial is turned. The accompanying illustration shows the application of this spacing indicator in connection with the multi-graduated precision grinder manufactured by this concern. The equipment is being employed for grinding "no-lead" hobs used in milling die-head chasers having eleven threads per inch, which necessitates accurate spacing from center to center on the threads of 0.0909 inch.

At the beginning of an operation on these chasers, the micrometer dial is revolved from zero until the reading is 0.0909 inch; then the lathe carriage is advanced until the stop-pin, by contacting with the plunger of the dial indicator, causes the needle of the indicator to register zero. To advance the grinding wheel another space after one thread has been ground, the micrometer dial is released on the screw, turned back until it registers zero, again locked in place on the screw, and revolved to the 0.0909-inch graduation, after which the carriage is advanced to bring the stop-pin against the dial plunger indicator as before.



Frick Spacing Indicator being used in grinding a "No-lead" Hob



Moline Multiple-spindle Automobile Cylinder Lapping Machine

MOLINE CYLINDER LAPPING MACHINE

A multiple-spindle machine designed for simultaneously lapping or honing all the bores of an automobile cylinder has recently been put on the market by the Moline Tool Co., Moline, Ill. This machine has the same general characteristics as the "Hole-hog" multiple-spindle drilling and cylinder boring machines built by this company, the principal difference being that the spindles can be reciprocated up and down as rapidly as desired while the laps are being revolved. This machine can be adapted for handling any type or size of cylinder by simply changing the center distance of the heads and the length of the stroke.

The machine is built with a stationary rail and a vertically sliding table. The crankshaft and connecting-rods that reciprocate the spindles are those provided on the automobile built by the customer. This arrangement gives nominally the same stroke as that of the automobile engine; however, a greater or lesser stroke can also be given to the spindles. The cylinder block is mounted on a fixture on the table while the latter is in a lowered position, and after loading, the entire unit is raised to the working position. In raising the table, the lap-closer block is also raised above the laps to permit the latter to enter the cylinder bores. Elevation of the table is regularly accomplished by revolving a handwheel which actuates spur gears and a rack pinion, but power elevation can be provided. The relation between the rotation and reciprocation of the spindles is controlled through slip gears.

There are two opposite opinions as to the best method of lapping, one being that

rapid rotation and slow reciprocation of the laps is the preferable method, and the other that rapid reciprocation and slow rotation or even indexing is better. The design of this cylinder lapping machine is such that any desired relation between reciprocation and rotation is obtainable. The rotation of the spindles is obtained through spiral gears, in the same manner as on the standard machines, and their reciprocation is accomplished by means of a rack and pinion, bevel gears, and clutches. Any stroke or position of stroke with respect to the cylinder block may be had by setting stops to suit. When an operation is completed, the laps or hones are withdrawn automatically. The machine is furnished with a pump and piping for supplying lubricant to the work. It is arranged with a clutch pulley that can be driven from a countershaft, lineshaft, or direct from a motor.

WATERBURY-FARREL SCREW SLOTTING MACHINES

Three standard sizes of automatic machines for slotting the heads of screws up to ½ inch in diameter and 4 inches in length are built by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. The smallest size is illustrated in Fig. 1. The blanks are fed automatically from a hopper into an inclined chute *A*, Fig. 2, from which they are delivered to a notched carrier dial *B*, which indexes automatically to transfer the screws to the slotting position. The saw is mounted in a swinging frame *C* by means of which the depth of cut can be regulated. The swinging feature is also convenient in changing the saw. In Fig. 2 the frame is shown thrown back to permit a more complete view of the carrier dial and the adjacent parts. When in the operative position, the saw is well guarded. Adjustments are provided for centralizing the saw. Motion is transmitted to the saw frame through a rod *F* which is connected to the adjustable block *G*. The saw-driving pulley has a heavy rim which serves as a balance wheel, and a buffer spring beneath the frame steadies the cut and obviates chatter. On the two smaller sizes of this machine the saw is driven by belt, and on the largest by a chain.

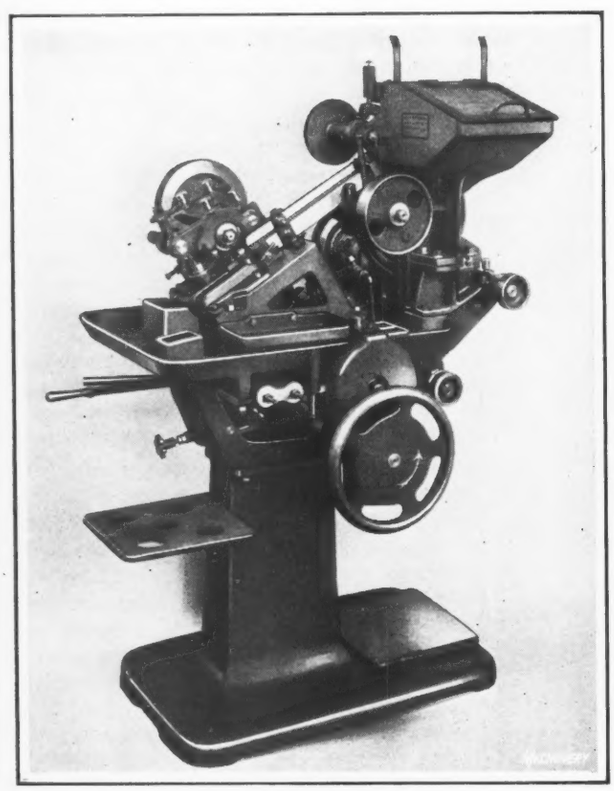


Fig. 1. One of a Line of Waterbury-Farrel Automatic Screw-slotting Machines

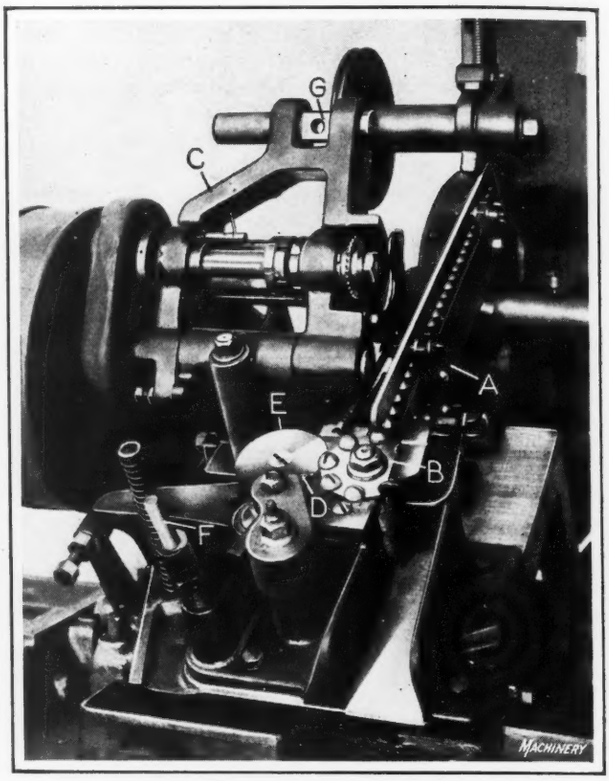


Fig. 2. Close-up View of the Saw Frame, Carrier Dial, Clamping Disk and Burr Remover

Burrs produced on the screw heads by the saw are clipped off by the auxiliary form tool *D*, which conforms to the shape of the head on the screw and is timed with the indexing mechanism of carrier dial *B*. The action of the arm that controls the functioning of the burr remover is sudden; it is snapped forward by a stiff spring and drawn back positively by a cam.

During the slotting and burring, the screw shank is firmly clamped by means of a disk *E*, attached to the short arm of a bell-crank lever which is actuated through the medium of a cam and an adjustable set-screw, causing the disk to bind against the screw shank which extends just beyond the periphery of the carrier roll. When the clamping disk becomes worn, its position may be easily changed to present a new clamping surface. As soon as the operation is finished, the work is released and the carrier dial indexed to the next position. This transfers another blank to the operative position and advances the slotted screw toward the point of release where the screw drops from the dial, and falls down a trough and into a receptacle beneath.

In the hopper there is a vertically operating slide or pick-up blade which reciprocates through the blanks and in its uppermost position forms an angular pocket into which the chute extends. The upper end of this blade is beveled toward the pocket, so that blanks which are lifted by the blade fall into the pocket. Some fall into the chute, while others fall against a cam-operated device which throws them back until they also become correctly located in the chute. Attached to this "kicker" there is a templet provided with an opening through which the screw heads pass. This is the only unit in the hopper-feeding mechanism that requires changing to adapt it to all sizes and styles of heads for a given sized screw shank.

On the belt-driven machine there is a belt shifter, operated by a handle extending to the front of the machine within easy reach of the operator, and on the motor-driven machine the motor switch may be correspondingly located. A feature of these automatic screw-slotting machines is the simplicity of adjustment and set-up. Cutting compound is delivered to the saw by a small pump from a tank supported on trunnions at the rear of the pedestal.

SUNDSTRAND RADIUS, INTERNAL AND SURFACE GRINDING MACHINE

A distinctive feature of the radius, internal, and surface grinding machine developed primarily for railroad shop use by the Rockford Milling Machine Co., Rockford, Ill., is that the long radius-bar employed in grinding the finished curved surfaces of locomotive radius-links is in the vertical position, and so the space occupied by the machine is reduced to a minimum. The machine is adapted to many typical railroad shop operations; for surface grinding operations, it is simply necessary to remove the vertical table and use the standard wheel-spindle for light and medium work or a special spindle for heavy work. In Fig. 2 the machine is illustrated set up for surface-grinding the cheeks of radius-links, the special extra heavy spindle being used. A planetary motion can be imparted to the spindle and an oscillating motion to the spindle head, to permit the machine to be used for grinding holes, as illustrated in Fig. 4, where a hole is being ground in one end of a locomotive side-rod.

Surfaces can be ground at radii of from 18 to 100 inches by means of the vertical radius-bar; such an operation is shown in Fig. 3 being performed on a radius-link. An oscillating movement is imparted to the grinding spindle and a swinging movement to the work. A special fixture is employed for holding the link on the vertical table. The pendulum mechanism is entirely independent of the rest of the machine, and when not required can be detached, or the radius-bar can be swung out of the way to facilitate surface and internal grinding operations. Other operations in railroad shops for which the machine can be conveniently applied are surface-grinding the sides of link-blocks, grinding the hole in link-blocks, and face-grinding the ends of these blocks.

The base of the machine consists of two heavy ribbed castings provided with bearing surfaces for the horizontal table and the spindle column, and secured at right angles

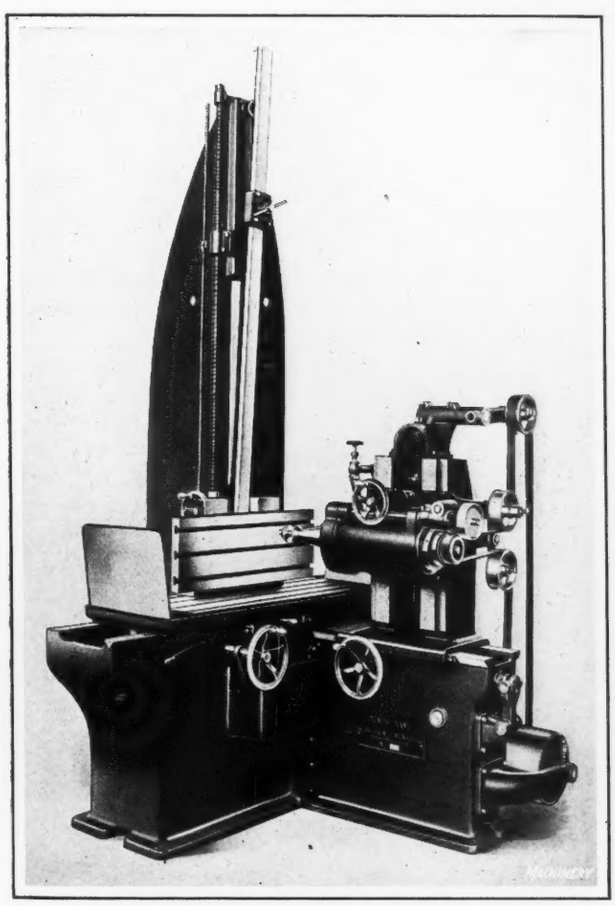


Fig. 1. Sundstrand Heavy-duty Radius, Internal, and Surface Grinding Machine

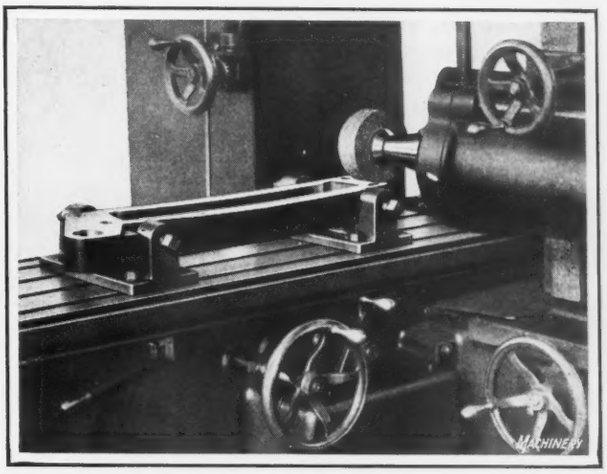


Fig. 2. Surface-grinding the Cheeks of Locomotive Links, using the Heavy Wheel-spindle

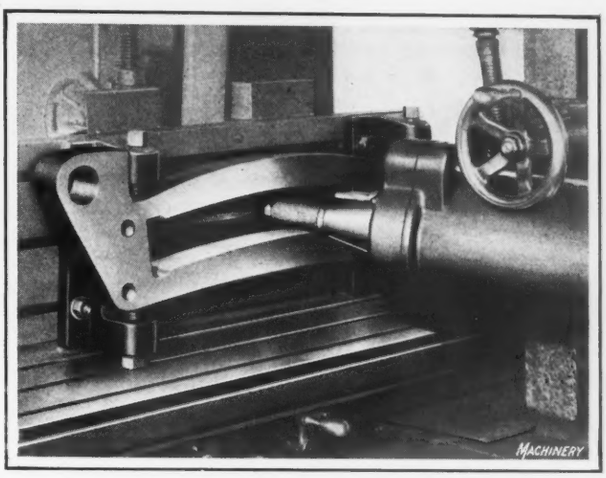


Fig. 3. Set-up employed in grinding the Curved Surfaces of Radius-links to the Desired Radii

to each other. The vertical column for the radius-bar is bolted to the rear of the main base, and to this column is attached the motor when the machine is arranged for a motor drive. The column is an iron casting about 10 feet 10 inches high, and is equipped with a radius-bar 1 inch thick by 3 inches wide which has ¼-inch graduations. The radius-bar is adjustable by means of a handwheel conveniently located relative to the operating position. The vertical table to which the work is attached in radius-grinding is secured to the radius-bar and controlled in its reciprocal motion by the horizontal table to which the vertical table unit is clamped. An automatic longitudinal feed is provided for the horizontal table in both directions, with either hand or power feed. The length of travel is controlled by two adjustable dogs. The hand starting lever is located at the front of the machine.

The spindle column is supported on wide bearing surfaces on the base, and the adjustable spindle head is mounted on dovetail bearings on the spindle column. Practically the entire driving mechanism is contained in the base below the spindle column. Horizontal adjustment of the column is regularly obtained by hand, but a power feed can also be furnished. The wheel-spindle runs in ball bearings and is provided with means for taking up wear, the necessary adjustments being made by turning a single nut. The spindle construction is such that sleeves of different sizes can be applied for various grinding jobs. An eccentric spindle provides, through gearing, the planetary motion to the spindle necessary for internal grinding. The planetary path may be up to 1¾ inches larger in diameter than the wheel.

A motor drive is recommended for the machine, but it may also be driven from a line-shaft or jack-shaft. A 7½-

horsepower motor running at 1200 revolutions per minute is specified. An oil-pump delivering coolant to the wheel through a flexible tube is located below the spindle column and draws the coolant from a reservoir in the base.

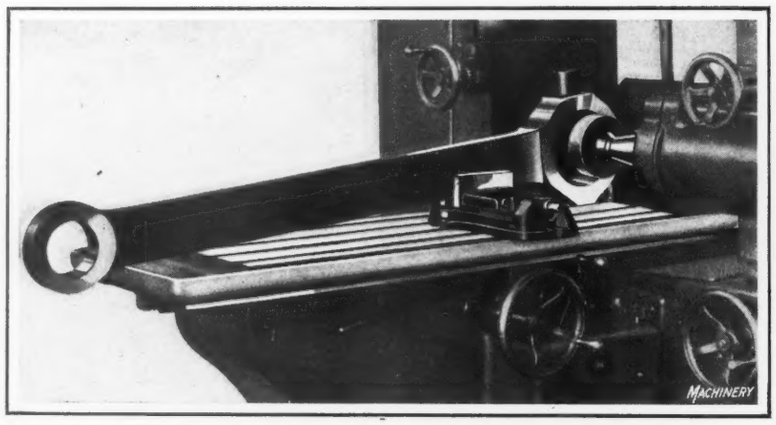


Fig. 4. Grinding a Hole in a Locomotive Side-rod on the Sundstrand Grinder

Some of the principal specifications of this Sundstrand grinding machine are as follows: Working surface of vertical table, 12 by 36 inches; working surface of horizontal table, 16 by 48 inches; longitudinal feed of horizontal table, 50 inches; vertical feed of wheel-spindle, 20 inches; cross-feed of wheel spindle, 14 inches; total height of machine, 12 feet 2 inches; floor space required, 81 by 114 inches; and net weight, approximately 6800 pounds. Manning, Maxwell & Moore, 119 W. 40th St., New York City, are the exclusive selling agents for this machine in the middle-western, eastern and southern states, and the Herberts Machinery & Supply Co., Los Angeles and San Francisco, Cal., in the Pacific Coast states.

ROLLWAY "MAXIMUM-TYPE" BEARINGS

A new series of bearings known as the MDW, which represents "maximum double width," has been brought out by the Rollway Bearing Co., Inc., Syracuse, N. Y. These bearings are intended for use under heavy load conditions combined with severe shocks, where there might be a tendency for a narrower standard inner race to cut into the shaft, and are the result of many years of experience in designing bearings for heavy-duty service. They are especially suitable for installation in railway car motors and journals and in heavy gear and chain drives. The use of a wider inner race also permits a lighter press fit, which is appreciated when bearings must be removed from a shaft.

The bearing is self-contained, having outer and inner races of a heavy channel cross-section, which serves the double purpose of providing both bearing and guiding surfaces for the rollers, and thus eliminates the necessity of a retainer. The diameter of the bore and the over-all diameter of the MDW type is standard, as is also the width of the outer race, but the inner race is of a standard double-row width. The material used in making this bearing is a heat-treated, high-chrome, high-carbon steel. In the different sizes manufactured, the bore diameter ranges from 0.7874 to 10.2363 inches.

In addition to the bearings described, this company has enlarged its regular line of standard sizes to include all the commonly used sizes, and has added a complete line of single- and double-direction roller thrust bearings of both aligning and flat washer types. Fig. 2 shows a double-acting aligning type thrust bearing of the metric interchangeable series.

ANDERSON HOPPER FEED FOR TAPPING MACHINE

The dial-feed multiple-spindle tapping machine built by the Anderson Die Machine Co., Iranistan Ave., near Admiral St., Bridgeport, Conn., which was described in February, 1922, MACHINERY, may now be equipped with an automatic hopper feed. The hopper is mounted on a bracket fastened to the under side of the pan in which the dial rotates, and it is driven by an independent motor. This independent motor drive is used to fill the chutes or runways leading from the hopper to the dial with work previous to starting the machine for tapping the pieces. Three chutes lead from the hopper to the dial, the mouths or exits from the hopper being so arranged that the parts are permitted to be fed only in one way; that is, they are turned upside down for the tapping operation. The hopper feed illustrated is used in tapping knurled battery nuts. In the event that a nut lodges in a hopper exit with the opposite side turned up, hooks or ejectors arranged on the inside of a rotary plate that forms the bottom of the hopper will dislodge it.

At the lower end the chutes are adjusted to such a position that when the dial is stationary while the tapping is

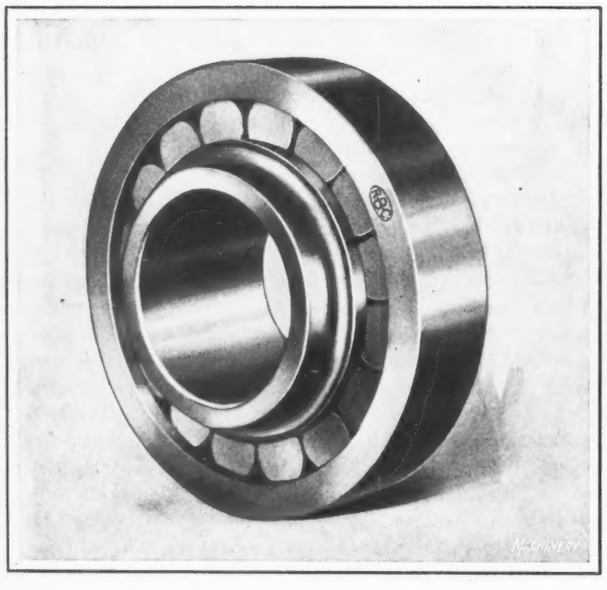


Fig. 1. Rollway MDW Bearing intended for Heavy-duty Service

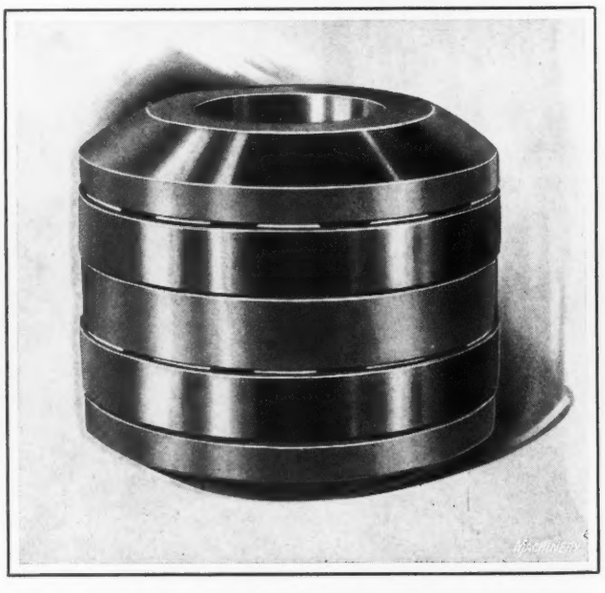
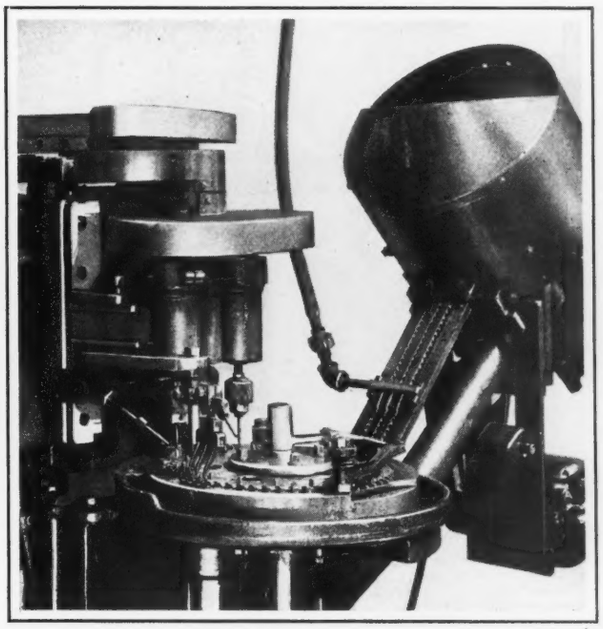


Fig. 2. Extra Heavy Thrust Bearing of Double-acting Aligning Type

being performed, the openings in the dial align with the three runways. Through the action of gravity, the parts then force themselves into the openings in the dial. As the dial indexes, a stop or gate closes the lower end of the three runways and prevents the nuts in the chutes from projecting and interfering with the rotation of the dial.

The ratchet that controls the dial feed has eighteen teeth, and for each of these there are three openings in the dial, so that at each stroke of the machine three nuts are tapped. The nuts are clamped in the tapping position by means of a cam mounted on a vertical shaft. Variations in the diameter of nuts are provided for. Three fingers mounted on a bracket which moves up and down with the taps, and which is so constructed as to swing outward, force the nuts out of the dial after tapping, when this is necessary. This ejection, must be positive, as a nut remaining in the dial would prevent proper indexing. The machine is timed to run at 40 strokes per minute, and on actual production three machines running on a 20-hour day schedule have tapped from 375,000 to 421,000 nuts.

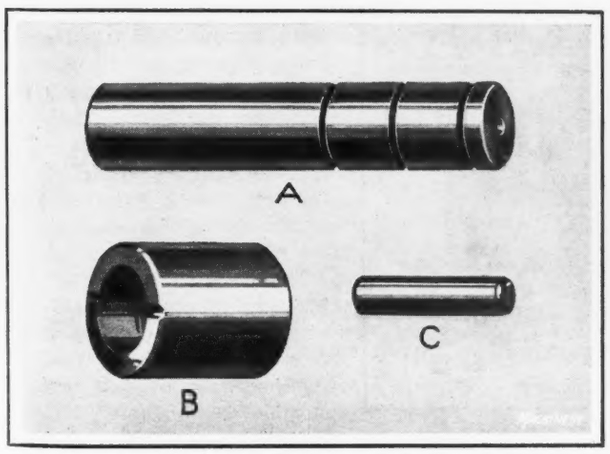


Automatic Hopper Feed for Anderson Dial-feed Multiple-spindle Tapping Machine

DANLY STANDARD LEADER AND DOWEL PINS AND BUSHINGS

Leader and dowel pins and bushings have been added to the line of standard die parts manufactured by the Danly Machine Specialties, 4911 Lincoln Ave., Chicago, Ill. The leader pins are made of steel, carburized, and hardened and ground on centers to within plus or minus 0.0002 inch of the nominal diameter. Care is taken in carburizing to insure that the leader pins will have a heavy case, and they are given a double quenching to refine and toughen the core. Irregularities left in grinding are removed by lapping to give a full wearing surface for the bushing. These leader pins are made in various diameters from ½ to 1½ inches, and in lengths from 4 to 9 inches. The allowance for a pressed fit ranges from 0.00125 to 0.002 inch.

Standard bushings are made in both straight and shoulder types, in various sizes ranging from ½ to 1½ inches inside diameter. The length of standard straight bushings ranges from 1½ to 2 inches, but extra long bushings having a length of 3¼ inches are made in sizes of from ⅞ to 1½ inches inclusive. The bushings are made of steel, carburized and hardened and ground to within minus 0.0002 inch of the listed inside diameter to provide an allowance for lapping. There is a pressed fit allowance of 0.002 inch on the outside diameter. The dowel-pins are made of drill rod, hardened, tempered, and ground to within plus or minus 0.0001 inch of the listed diameters. They are also carried in stock 0.001 inch over-size for repair or renewal work, where holes have become enlarged, or where a reamer has cut oversize. It is claimed that these hardened pins can be driven in or out of holes without upsetting or bulging. The diameters range from 3/16 to ½ inch, and the lengths from ⅞ to 2¾ inches. The illustration shows a leader pin at *A*, a straight bushing at *B*, and a dowel-pin at *C*.

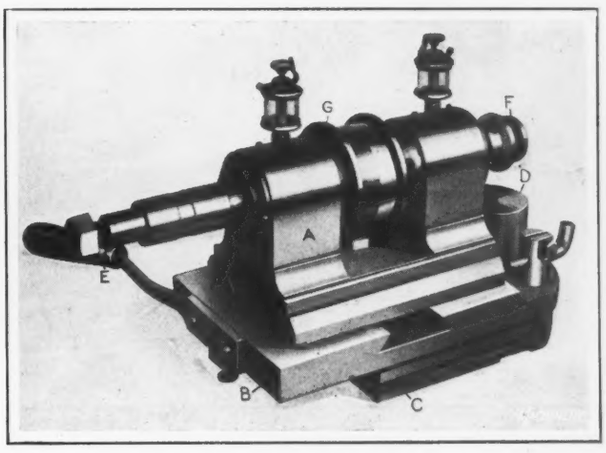


Danly Standard Leader and Dowel Pins and Straight Bushing for Die Sets

SCHWAGEL RADIUS GRINDING FIXTURE

An attachment primarily intended for use in grinding circular or other surfaces at a radius, but which may also be employed for milling operations, etc., has been placed on the market by Nicholas Schwagel, 123 E. Third St., Dayton, Ohio. From the illustration it will be seen that the device consists of a spindle head *A*, a pivoted base *B* on which the spindle head is mounted, and a main base *C* clamped to the machine on which the fixture is used. The pivoted base *B* may be swung on a large-diameter taper stud, which is screwed into a tapped hole in the base *C* and has a bearing in cap *D*, the latter being screwed into the pivoted base. The base is swiveled by means of handle *E*.

Either the work or a grinding wheel may be mounted on the end *F* of the spindle; assuming that a piece of work is placed on the spindle and that the fixture is positioned relative to a grinding wheel, as base *B* and the spindle head are swung about the taper stud, the work will be ground at a radius equal to the distance between the point where the work contacts with the wheel and the center of the taper stud about which the fixture is swung.



Schwagel Fixture for Use in grinding Circular and Other Work

Circular parts are ground to a radius by driving the spindle with a belt connected to pulley *G*. Head *A* has a longitudinal dovetail slot, and base *B* has a transverse dovetail slot. By means of a stud on which there are two opposite taper or conical disks, each of which fits one of the dovetail slots, the head and base are clamped together. With this arrangement the spindle head may be located in various longitudinal, transverse and angular positions, the different positions providing for handling a large range of work.

Base *C* has three rectangular grooves on the upper side, which radiate from the taper stud, and base *B* has a corresponding slot on the bottom which may be brought into line with any one of the slots in base *C* and a bar inserted in the slots to lock the bases together for such operations as plain, cylindrical, bevel, or taper grinding. For other classes of work, as for example, irregular or rectangular pieces, spindle head *A* may be replaced by a plain base having a T-slot by means of which an ordinary machinists' vise or a special jig or fixture may be attached for holding the work.

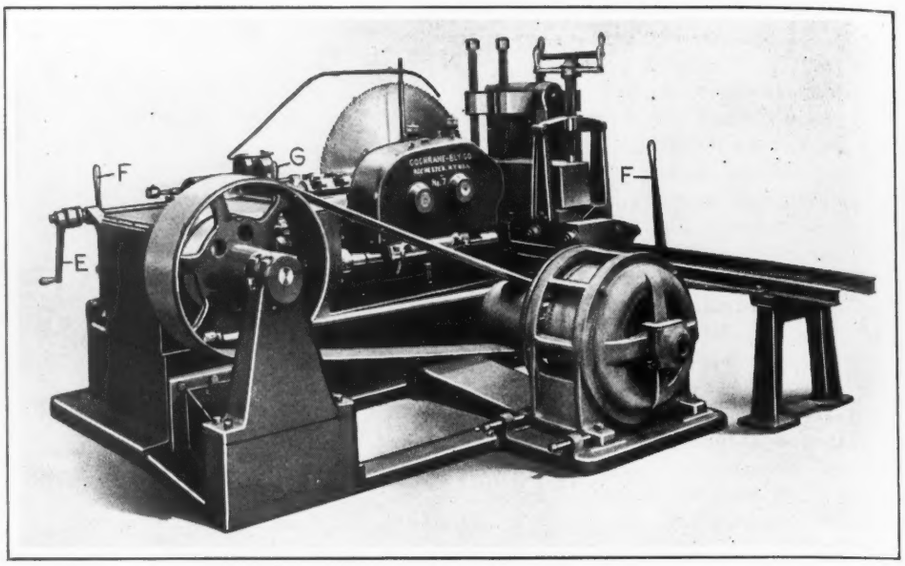


Fig. 2. Rear View of the Sawing Machine, showing the Motor Drive

COCHRANE-BLY METAL-SAWING MACHINE

A cold-sawing machine known as the No. 7, which has sufficient capacity for cutting 13-inch round, 12-inch square, or 10- by 15-inch rectangular stock, has recently been placed on the market by the Cochrane-Bly Co., Rochester, N. Y. When the machine is equipped with a 60-degree fixture for multiple cutting, two hundred and twenty-nine ½-inch bars, fifty-three 1-inch bars, nineteen 2-inch bars, or four 5-inch bars can be held in the fixture at one time. The bed of the machine is set in a deep pan which catches all oil and chips falling from the work, the oil being drained into a reservoir from which it is again delivered to the work by a geared pump. The surfaces of the bed to which the saw carriage is fitted are scraped to surface plates to insure an accurate assembly of the two units. The saw arbor is hardened and ground and fitted into a solid bearing.

The feed-screw is located directly in line with the center of the saw arbor and as close as possible to the saw blade so as to bring the feeding pressure as nearly as possible in line with the saw. The nut on the feed-screw is split and adjustable endwise to permit the elimination of all lost motion in the screw, and adjustable hardened steel nuts provide for taking up lost motion between the screw and the gear-box. The feed-screw is driven by worm-gearing and compound spur gears, a tumbler operated by means of handle *A* providing six feed changes; additional changes are provided through sliding gears operated by knob *B*. The sliding gears mesh with gears on the worm-shaft. Eleven feeds are obtainable in all, ranging from ½ to 2½ inches per minute.

The feed is started, stopped, and reversed from either the front or back of the machine, by means of levers *C*. A double pawl holds the clutch-block in a neutral position, in engagement with the feed gear or allows it to engage with the reverse gear. The pawls are lifted by means of a rack and pinion mechanism operated by levers *C*. A movement of either lever to the left raises the feed pawl and trips the machine into neutral; further movement of the lever raises the neutral pawl and trips the machine into reverse, automatically returning the saw carriage at high speed to a point determined by the setting of an adjustable stop-collar on trip-rod *D*. Another adjustable stop-collar lifts both pawls at the same time, automatically tripping the machine from feed to reverse. Levers *C* are moved to the right to release the reverse clutch and engage the feed clutch. The carriage can be adjusted to or from the work by means of cranks *E* located at each end of the machine.

The machine is driven by a friction-clutch pulley on the hub of which there is an oil reservoir with a capacity for holding sufficient oil to last several months. The clutch is controlled through levers *F* from

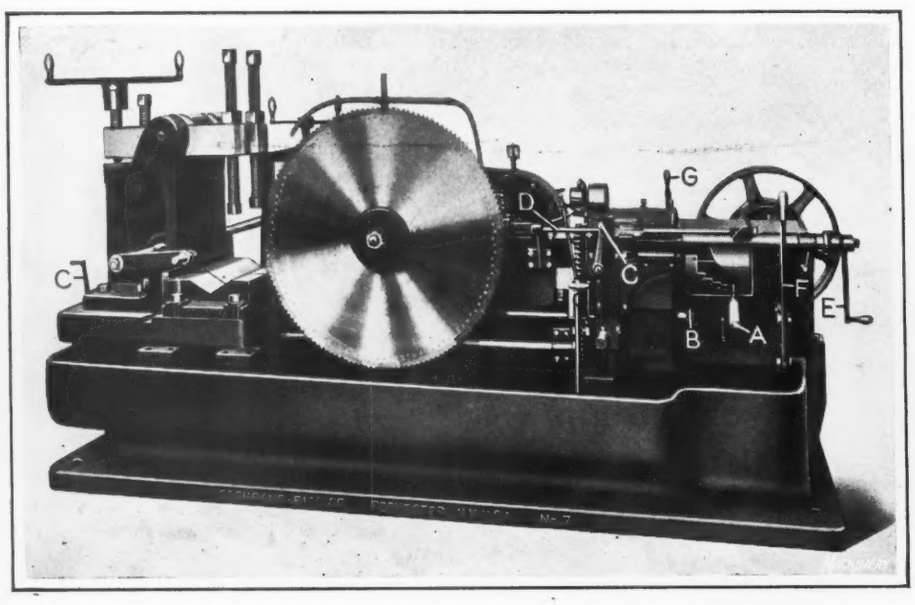
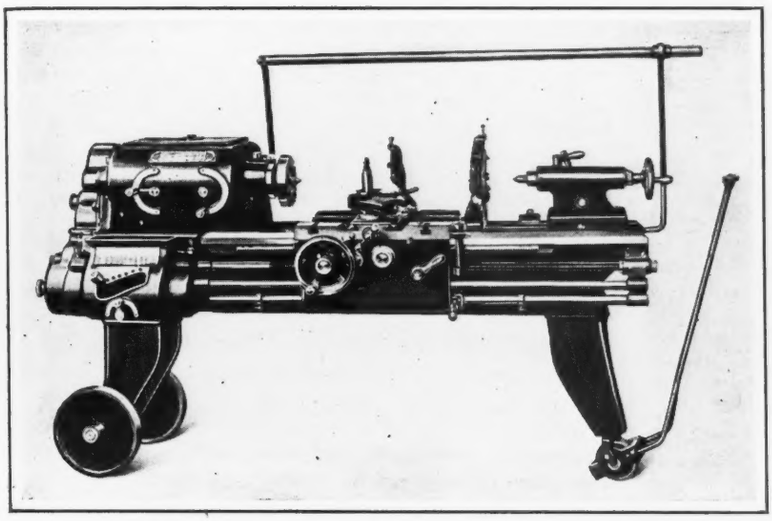


Fig. 1. Cochrane-Bly Cold Saw which has a Capacity for 13-inch Round and 12-inch Square Stock



Sundstrand Gear-head Lathe equipped with Wheels to permit Ready Transportation about the Shop

either the front or back. Ring-oiling bearings are supplied for the driving shaft. There are three cutting speeds of 30, 40 and 50 feet per minute, any one of which is obtained through lever *G*, by sliding a cone of gears on the driving shaft. All gears in the machine, except the worm-gears, are made of steel and are fully enclosed and run in an oil bath. A set of miter gears on the driving shaft, an arbor gear, and an intermediate gear in the worm-gear box on the carriage are made of nickel steel and casehardened, and the pinions meshing with these gears are made of chrome-nickel steel and hardened. The worm-gears are made of phosphor-bronze. The driving worm is made of steel, and hardened; it is provided with a ball-thrust bearing and runs in oil.

The vise has double clamping screws so as to hold the stock at two points. These screws, as regularly furnished, are hand-operated, but a vise equipped with clamps operated by compressed air can also be furnished. The regular equipment includes a stock-feeding device, which is operated by simply turning a crank to pulling the bar through the vise. The stock-support carriage is moved by means of a chain and sprocket and a crank that is back-geared to the sprocket shaft. It is said that one operator can easily adjust a 12-by 12-inch billet in the vise. The top of the yoke on the carriage is hinged, and may be opened up to facilitate placing a bar in the machine.

Some of the principal specifications of the machine are as follows: Diameter and thickness of saw blade, 37 and 9/32 inch, respectively; diameter of saw arbor, 6 inches; area of work-table, 30 by 27½ inches; speed of driving shaft, 300 revolutions per minute; diameter and face width of driving pulley, 24 and 9 inches, respectively; motor required, 20 horsepower, running at from 860 to 900 revolutions per minute; and weight of machine, approximately 12,600 pounds.

To determine the power required at various speeds and feeds, extensive tests were made in which an 8-inch square billet of 0.40 per cent carbon, open-hearth steel was cut with the following results: With a cutting speed of 30 feet per minute and a feed of ½ inch per minute, an average of 4.8 horsepower was consumed; with the same speed and a feed of 1 inch per minute, 6.85 horsepower; with a feed of 2 inches per minute, 10.97 horsepower; and with a feed of 2½ inches per minute, 14.48 horsepower. With a cutting speed of 40 feet per minute, and a feed of ½ inch per minute, 5.13 horsepower was consumed; with a feed of 1 inch per minute, 7.3 horsepower; with a feed of 2 inches per minute, 12.66 horsepower; and with a feed of 2½ inches per minute, 14.71 horsepower. With a cutting speed of 50 feet per minute and a feed of ½ inch per minute, 5.37 horsepower was consumed; with a feed of 1 inch per minute, 7.86 horsepower; with a feed of 2 inches per minute, 13.71 horsepower; and with a feed of 2½ inches per minute, 15.51 horsepower.

SUNDSTRAND PORTABLE GEARED-HEAD LATHE

A 15-inch geared-head lathe provided with wheels to make it portable has been brought out by the Rockford Tool Co., 2400 Eleventh St., Rockford, Ill. This machine is intended particularly for use in railroad shops and shipyards. It is of the same design and specifications as the Sundstrand 14-inch tool-room lathe described in January, 1922, MACHINERY, with the exception that the oil-pan is omitted, and the wheels and their brackets substituted. Also, when the portable machine is equipped with a motor drive, the motor is mounted directly on the head-stock. The distance between centers with a 6-inch bed and the tailstock flush with the end of the bed is 32 inches, and the weight of the lathe with a bed of the length mentioned is approximately 2250 pounds.

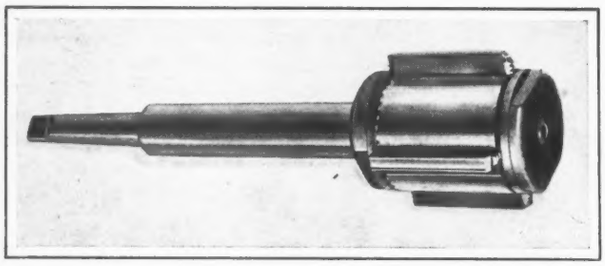
YALE & TOWNE INDUSTRIAL TRUCK

To meet the general requirements of economical intra-plant movement of materials, the Yale & Towne Mfg. Co., Stamford, Conn., has brought out the "Yale Model K-20" industrial truck shown in the accompanying illustration. This truck is intended for handling miscellaneous units of material, which can be placed on the platform by hand, chain block, electric hoist, etc. Auxiliary equipment which has been designed for use with it includes a gravity dump body for handling loose materials, and an electrically operated swinging-boom crane. Large wheels and full spring suspension permit efficient operation over rough floors and roads.

The truck is equipped with a spur-gear unit power axle and ball bearings protected from dirt and properly lubricated. The design and construction of the controller is said to insure durability and efficiency under the most severe service conditions. The majority of single parts and units are standard and interchangeable with those of all other models in this series of Yale industrial trucks.



Yale Industrial Truck for Intra-plant Transportation of Materials



Lambert Universal Expansion Reamer

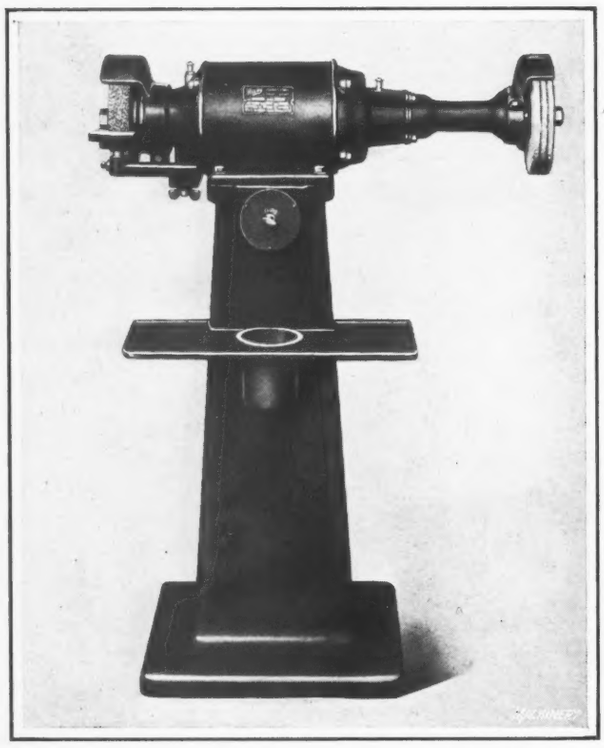
LAMBERT EXPANSION REAMER

An expansion reamer is being manufactured by the Lambert Tool Co., E. 55th St. and Euclid Ave., Cleveland, Ohio, in various nominal sizes from 1 inch up. The 1-inch size may be expanded to 1¼ inches in diameter, the 3-inch size to 4 inches in diameter, and intermediate sizes proportionate amounts. These expansion adjustments are made by releasing the lock-nut and turning the blade cylinder. Scrolls at each end of the blades mesh with teeth cut in the blade ends and cause the blades to expand. The lock-nut is tightened, after an adjustment, to bind the scrolls securely against the ends of the blades and hold the blades positively to the desired diameter. The cylinder simply serves as a housing to support the blades. The diameter of the tool may be readily increased by thousandths of an inch to any dimension within the limits of a particular size.

HISEY-WOLF GRINDING AND BUFFING MACHINE

A new direct motor-driven combination grinding and buffing machine, equipped with a motor of one-horsepower capacity, has been brought out by the Hisey-Wolf Machine Co., Cincinnati, Ohio. The machine may be furnished with a floor stand as illustrated, or with a base for mounting on a bench. It is adapted for a large variety of work requiring the use of grinding, buff, wire-brush, or rotary wire-rasp wheels.

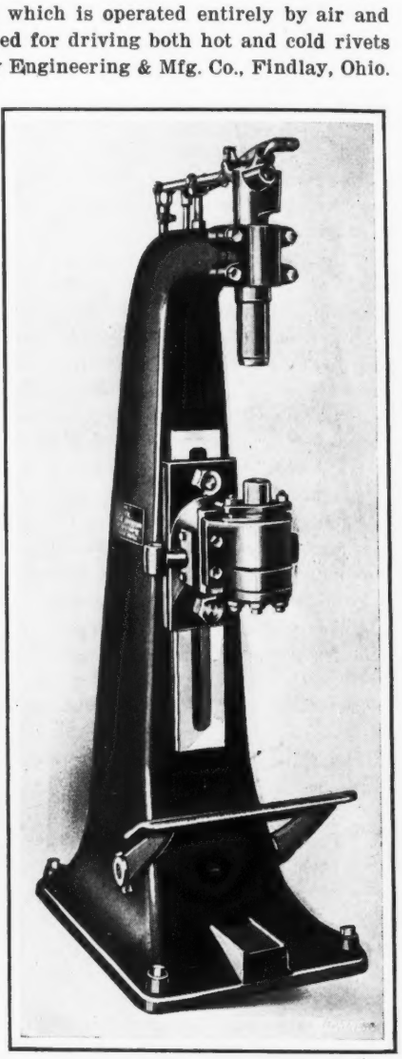
In the general construction details, it is similar to the standard lines of Hisey ball-bearing grinding and buffing machines. The spindle extension is a separate unit and is connected to the motor armature shaft by means of a clutch. Each shaft unit is supported by two ball bearings so as to make the entire spindle and general construction rigid. Alternating-current, single-phase machines are intended for operation by current taken from a lamp socket or lighting circuit, while two- or three-phase machines are intended for operation from power-circuit lines only. Direct-current machines can be furnished for currents of from 80 to 250 volts. Standard grinding and buffing wheels for the machine are 8 inches in diameter by 1½ inches wide, and the distance from the floor to the center of the spindle is 39½ inches. The approximate weight of the machine is 390 pounds.



Hisey-Wolf Direct Motor-driven Grinding and Buffing Machine

FINDLAY PNEUMATIC RIVETING HAMMER

A riveting machine which is operated entirely by air and which may be employed for driving both hot and cold rivets is built by the Findlay Engineering & Mfg. Co., Findlay, Ohio. The model A machine drives hot rivets up to ⅝ inch in diameter and cold rivets up to 7/16 inch, while the model B drives hot rivets up to 1 inch in diameter and cold rivets up to ⅝ inch. Rivets up to 10 inches in length can be handled regularly, and rivet hinge pins up to 16 inches long can be handled by means of a special adjustment. It is said that the machine not only produces a head on the rivet, but also upsets the body and fills the hole. The dolly-bar or anvil is air-operated and follows up a rivet with a uniform pressure until the rivet is driven.



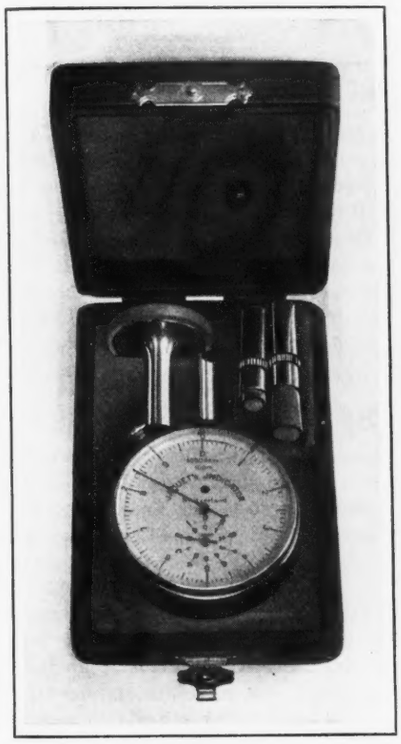
Findlay Pneumatic Riveting Hammer

The piston, anvil, and all other working parts are made from chrome-vanadium steel and are heat-treated, and the frame, bracket and cylinder are semi-steel castings. As the machine is not driven from shafting or a motor, it can be set up wherever it is most convenient for the work, provided compressed air having a pressure of from 80 to 100 pounds per square inch is available. The force of the blow delivered by the hammer is of wide range, so that the equipment can be used just to make a head, as required in hinge work, or to actually upset the largest sized rivet and fill the hole. The force of the blow is controlled by depressing the foot-pedal. The machine is used by automobile manufacturers to rivet cam and anchor brackets on rear-axle brake disks, and to rivet in place frame brackets, spring hangers, gussets, tank straps, etc. The model A machine weighs about 550 pounds, and the model B, 650 pounds.

O-Z DIRECT-READING TACHOSCOPE

A direct-reading tachoscope which is a combined anti-magnetic chronometer and revolution counter has been placed on the market by O. Zernickow, 15 Park Row, New York City. The instrument shows speeds in revolutions or feet per minute, the speed being determined in six seconds. In using the instrument, the spindle or disk wheel is held against a revolving shaft, and the push-button is depressed and permitted to fly back. Then when the spindle or disk wheel comes to rest, the speed in revolutions or feet per minute can be read on the dial. The disk wheel is used in finding the speed in feet per minute.

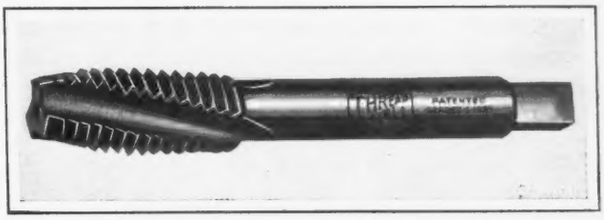
The standard time unit of six seconds is controlled by means of a precision watch movement in the indicator, 1½ seconds being allowed for starting and stopping the watch movement and for automatically switching the counting mechanism in and out at the beginning and end of the operation. The push-button lever is also used to wind the watch mechanism, and it automatically returns the counting mechanism to zero from previous readings. The last previous reading remains on the dial until the indicator has been placed in position on the part being tested, and then when the finger is pressed on the button and the button flies back, the counter is reset and the watch wound. One revolution of the large pointer indicates 1000 revolutions of the shaft tested or a distance traversed of 333 1/3 feet when the measuring disk is attached; and one revolution of the small pointer indicates 10,000 revolutions of the shaft or a distance traversed of 3333 1/3 feet. The instrument is designed for use with speeds up to 30,000 revolutions per minute. The dial is 2 inches in diameter, and the instrument weighs about 6 ounces.



O-Z Direct-reading Tachoscope

WELLS "THREADWELL" SPIRAL-FLUTED TAP

A line of "Threadwell" right-hand spiral-fluted taps in which the thread is ground, is manufactured by the Wells Corporation, Greenfield, Mass., in nine screw-gage numbers from 2 to 14, inclusive, and ten fractional sizes from ¼ to 1 inch, inclusive. Each cutting edge has three points of clearance, due to the rake angle of the spiral, the rake angle of the hook in the flutes, and the clearance of the eccentric relief. The tap is said to be designed on the same principle as a properly ground lathe tool, and these clearances are similar in effect to the back rake, side rake, and under-cut clearance of a lathe tool. The right-hand spiral flutes curl the chips and convey them out of the hole.



Wells "Threadwell" Spiral-fluted Tap

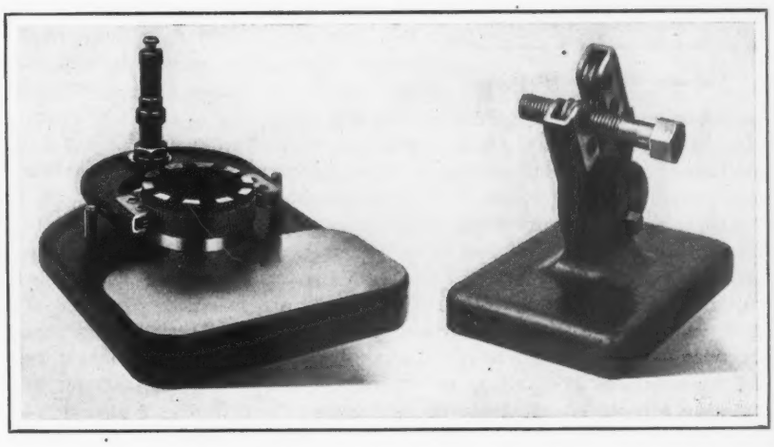
The tap is regularly made with a short "plug" chamfer for tapping all holes except blind holes where a full thread is necessary clear to the bottom. In such cases a very short chamfer is ground on the tapping end. In addition to the eccentric relief, an extra chamfer is given at the point where the taper and straight portions of the tap would otherwise meet. It is said that this double taper results in a more even distribution of the cutting strains and makes the tap less liable to breakage; in addition, less power is required for operating. The edges of the starting or chamfered threads are rounded, and all sharp corners removed to narrow the teeth and enable them to catch a thread without a reaming effect. Accuracy, both in diameter and lead, is guaranteed within 0.0005 inch.

BURKE MOTOR-DRIVEN BENCH DRILLING MACHINE

The No. 2 heavy-duty bench drilling machine built by the Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio, which was described in April, 1923, MACHINERY, may now be obtained with a motor drive. The motor is of ½ horsepower capacity and drives the lower cone pulley through a Morse silent chain, which is adequately guarded. The motor is mounted on an extension of the regular base of the machine. This machine is intended for drilling holes up to 9/16-inch diameter and can drill to the center of a 12-inch circle. The weight of the motor-driven machine is approximately 240 pounds.

JOHN-SONS THREAD-GAGE VISE AND FIXTURE

A vise and fixture have been developed for use in conjunction with the adjustable thread snap gages manufactured by the John-Sons Gage Works, 67 Blue Hills Ave., Hartford, Conn., which were described in September, 1922, MACHINERY. The vise, which is shown at the right in the illustration, can be used with any style or size of these gages. It is rigid in construction and holds the gage in place by clamping with a collar-head screw. It is shown holding a gage



Fixture and Vise designed for Use with John-Sons Adjustable Thread Snap Gages

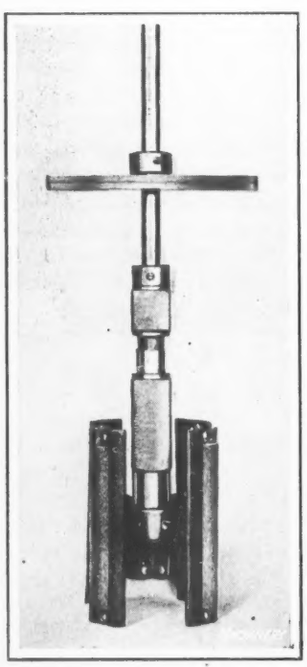
in a tilted position with a cap-screw between the gaging rolls.

The fixture, which is shown at the left of the illustration, may be used with any style of these gages for work larger than two inches in diameter, such as casings, shells, lock and adjusting nuts, or sleeves and bearing retainers. The finished portion of the base on which the work slides is a hardened steel plate, which is ground in position after being fastened on the casting. Through an arrangement of springs in the stem, the gage is made sufficiently free to obtain the necessary alignment between the gaging rolls and the threads on the part being gaged. This eliminates any tendency toward cross-threading.

The position of the gage is regulated by means of the adjusting bolt which projects through the hole in the handle. There is a provision which insures that the gage will always be parallel with the working surface of the base. By giving the work a quarter turn and gaging it a second time, an out-of-round thread is readily detected, and by grasping the handle and elevating and depressing the gage, a taper thread will also be revealed. After the handle is released, the gage will return to its original position.

STIMSON EXPANSION HONE

A patented device for honing the bores of automotive cylinders has been recently placed on the market by the Stimson Engineering Co., 598 Sixty-eighth Ave., Milwaukee, Wis. In operation, a strap which fits loosely on the shaft rests on top of the cylinder, and a collar on the shaft acts as a stop to prevent the honing stones from passing through the bottom of the cylinder. The position of the strap and collar is adjustable along the shaft. Each shoe of the hone is connected through links which center on a central cone, and therefore one shoe cannot be expanded without all four shoes being expanded at the same time. The shoes pivot on the links, and thus insure alignment and overcome any irregularities that may wear in the stones. The central cone is adjusted longitudinally by means of a coil spring within the knurled sleeve. This sleeve is pulled back in placing the hone in a cylinder bore.

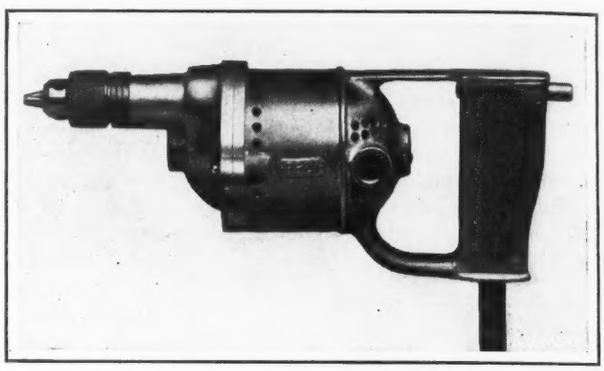


Stimson Expansion Hone

Two sets of shoes are provided, one to suit bores from 2¾ to 3½ inches in diameter, and the other for bores from 3½ to 4¼ inches in diameter. The shoes are easily changed, as each one is held in place by means of one cotter-pin. The stones have a dovetailed mounting on the shoes, which gives them a support on the sides and bottom for their entire length. If the stones become broken, the pieces can be used up because they will remain within the dovetail. This tool may be driven by any ordinary ½-inch electric or air drill or by a drilling machine. It is said that it will true up any cylinder bore, correct errors that may exist due to the piston travel, and eliminate the necessity of regrinding an entire cylinder block to maintain a balanced engine when only one of the cylinders requires regrinding.

U. S. AUTOMATIC PORTABLE ELECTRIC DRILL

A ¼-inch portable electric drill designated as the "U. S. automatic" has been placed on the market by the United States Electrical Tool Co., Cincinnati, Ohio. The handle is cast integral with the aluminum body, and contains a switch lever at the extreme top of the grip. In addition to being located in a convenient position for the operator's forefinger, the lever also forms a grip support when the drill is running.



United States Portable Electric Drill

The motor is of the universal type for operation on direct- or alternating-current circuits. S K F ball bearings are used, and the gears are made from chrome-nickel steel, hardened, and run in grease. A three-jaw screw-back chuck is provided. A bench-base, arbor, and wheel can be supplied to adapt this drill for use as a grinder, and it can be mounted on a drill stand or post bracket to form a bench or bracket drill. The weight of the drill is about 5¾ pounds, and its over-all dimensions, 10 by 4 inches.

VAN KEUREN REFERENCE GAGE SET

A set of reference gages which includes the fractional-inch or common shop sizes has been added to the line of precision measuring tools manufactured by the Van Keuren Co., 362 Cambridge St., Boston 34, Mass. This set contains the following gages: 0.0625, 0.125, 0.1875, 0.250, 0.3125, 0.375, 0.4375, 0.500, 0.5625, 0.625, 0.6875, 0.750, 0.8125, 0.875, 0.9375, and 1.000 inch, and in addition to these sixteenth-inch sizes, 0.09375 (3/32) inch and 0.078125 (5/64) inch, which give combinations in thirty-seconds and sixty-fourths of an inch. The set is particularly suitable as a reference standard for use in measuring steel balls and many other products of which the standard sizes are fractional-inch dimensions. A Bureau of Standards certificate of accuracy is provided with the gages, and they are furnished in a case.

BENCH STAND FOR PORTABLE DRILLS

An improved bench stand intended for use in connection with portable hand drills to convert them into bench equipment has been placed on the market by the Standard Electric Tool Co., Cincinnati, Ohio. The vertical column is made of a 1¾-inch square steel bar. The base is provided with T-slots for fastening work on it. This stand is made for ⅜-, ½-, 9/16-, ⅝-, ¾-, and ⅞-inch drills. The brackets that support the drill can be easily raised or lowered by means of a lever, and there is a quick return tension which is adjustable.

Some of the specifications of this stand are as follows: Height from bottom of base to top of vertical column, 36 inches; vertical adjustment of drill, 9 inches; distance from column to center of drill spindle, 6 inches; horizontal adjustment, a complete circle; vertical travel of drill when operated by lever, 4½ inches; net weight, 85 pounds.

MAKING LEATHER BELTS ENDLESS

By LOUIS W. ARNY

In July MACHINERY, general information was given concerning the tools used for making belts endless and the procedure in making the laps for the joint. This article will deal with certain variations in the practice of making endless belt joints, to meet different conditions.

Belts that are made endless may be divided into three classes: First, those that have been endless and that it is desired to shorten; second, those that have been running either with a laced joint or a metal fastener; third, new belts that have not yet been placed on the pulleys. These belts may again be divided into two classes including (a) those that are small enough to be thrown off the pulley and taken to a nearby bench, and (b) those that, because of their size, must be joined while on the pulleys.

To Shorten Narrow Belts that have been Endless

If a belt has been running endless, but has stretched a little so that the tension is reduced, it becomes desirable to shorten it. First it is necessary to determine how much shorter the belt must be. When this has been decided, find the joint that was made when the belt was last put on, and, with the point of a screwdriver, carefully open it, running the screwdriver under the point of the lap and working it toward the heel, taking care not to tear the leather.

If the belt is double, each ply of leather may have its own lap, or if it is a narrow belt it may have such a lap as is used on a single belt. Remove the belt to the bench; inspect carefully to see from which end it is most desirable to cut the surplus length, as determined by the relation of this end to any other joints in the belt; then bring the end on which it is decided to work nearly to the end of the bench, clamp the belt to the bench with bench clamps, and proceed to cut back the laps the desired distance.

To Make an Endless Joint in a Belt that has been Laced or Hooked

When an endless joint is to be substituted for a laced or hooked joint, the procedure is a little different. If the belt is loose enough on the pulleys so it can be tightened a number of inches equivalent to the number required to make the endless joint, the process consists in removing the belt to the bench as before, and making the necessary lap. If it is a single leather belt, or if it is a narrow double belt—say under 6 inches wide—an ordinary single lap may be used. This lap should be from 4 to 6 inches long, according to the width. The process then may be completed as described in the preceding article. If the belt is an old one, and the surface of the lap appears to be greasy, it should be cleaned with gasoline before attempting to cement it.

When the belt is not long enough to provide from its stretch sufficient material for the lap, it becomes necessary to prepare a piece to set into the belt. If it is a single belt, this may be a very short piece with a lap on each end, and then laps must be cut on the old belt to fit this piece, after which the cementing process is applied. When it is a narrow double belt, the piece inserted may be made in exactly the same way, but for a wider double belt the piece should be arranged so that it provides a separate joint for each of the two plies of the belt, so that these two joints are "broken" and do not come together. The ends of the belt then may be fitted to this insert.

Wider Belts that Cannot Conveniently be Carried to the Bench

With wide belts that cannot be conveniently carried to the bench, but must be joined while in place on the pulleys, the procedure is as follows:

If the belt is an old one that is to be shortened, first find the point on the belt at which the joint has been made, and bring the belt around to a place between the two pulleys where it may be most convenient to work. Then put on the clamps, one of the jaws above and one below the joint.

In putting on belts with clamps, the first requisite is to see that the middle line of the width of the belt corresponds exactly with the line midway between the centers of the rods of the clamps. Most clamps have this point marked on them. The next point, and a most important one, is to see that each pair of jaws of the clamps is exactly square with the edges of the belt. A little care here in drawing up evenly on the two rods will bring the two ends of the belt square and true, and will save effort and possibly a crooked belt.

Apply enough pressure to the clamps to take the tension of the belt off the joint, and then open the joint with the screwdriver, as before, cut down the new lap on one end with the spokeshave and the scraper, scrape off all the old glue from the lap on the other end, and proceed as before. This work can be best done on a clamp board, which fits between the rods and is attached to them.

Points on Making New Belts Endless

In putting on new belts, the laps should be made and the belt drawn over the pulleys, and then the clamps should be adjusted as just described. If the belt is to be bought, the belt-maker should be given the exact length around the pulleys, and he should be told whether it has been measured with a steel tape, a cotton tape, or a string, so that he can make the proper allowances; also "endless-open laps" should be specified.

In the case of new belts which it is desired to place on the pulleys endless, the first thing is to get the proper length of the belt. It is usual to estimate that the belt should be ⅛ inch to the foot, or 1 per cent less than the actual steel tape measure around the pulleys, and for small belts that are to be placed on the pulleys without the use of clamps, this will be found to be sufficiently accurate. For those belts that are to be put on with clamps, or where it is necessary that the belt shall be tight to produce tension, this allowance may be increased slightly, but not much. For single belts, this length must be increased by the length of one lap; the belt may then be cut to this total length, and the laps prepared and cemented as described.

For double belts, the plies should be opened for a little distance from the ends of the belts. This distance varies with the width of the belt, and consequently with the length of the lap desired; and it depends also upon whether there are any other joints near the ends. It may be desirable to make it long enough on one side of the belt or the other to include an existing lap, so that two laps shall not come close together on the same side of the belt. This distance must be long enough so that each lap will have a piece of whole leather on the opposite side.

When this distance is determined, one side of one end must be cut back the proper distance, and the opposite side of the other end. New belts can be prepared best at the bench. Clamps for very wide belts usually are made with a heavy screw-eye bolt in one of each pair of blocks, so that a chain hoist or a block and tackle may be used in the case of heavy belts to bring the ends of the belt to a point where the rods may be inserted.

With a new belt it is necessary to pull it up to a point where the laps fit perfectly. Then an observation should be made to see whether the belt is sufficiently tight. There may have been an error in measurement or insufficient allowance for stretch. If it is decided that the belt is not tight enough, it is a simple matter to scrape back the laps far enough to tighten it sufficiently.

There is some sort of agreement among belting men that single belts should be put on so that they have an initial tension, before starting, of 72 pounds per inch of width, and double belts in proportion. Ordinarily no method of measuring this tension is at hand, and it becomes a question of judgment of the workman, who must endeavor to determine the proper tension by watching the performance of his belts after they have been running, and gaging the frequency with which they have to be "taken up."



For Speed plus Quality— Brown & Sharpe Grinding Machines



Brown & Sharpe Plain Grinding Machines are made in a wide variety of sizes—all described in our General Catalog No. 137. Write for your copy today.

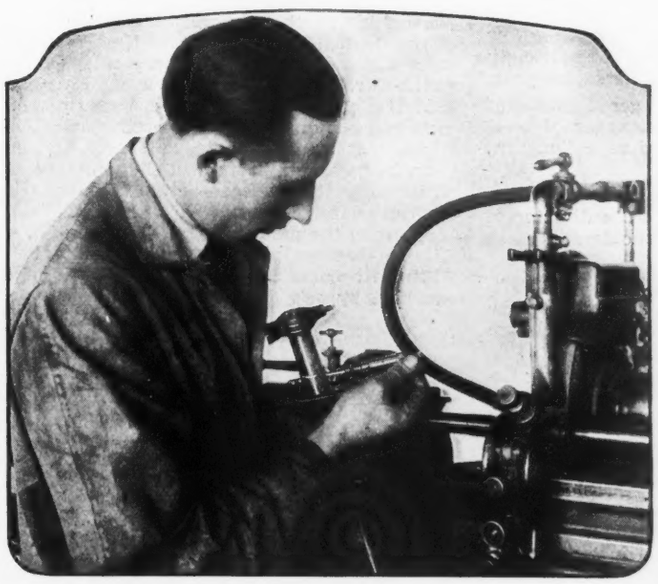
Quantity production to limits of .00025 ± is everyday practice on Brown & Sharpe Plain Grinding Machines. These sturdy units have the accuracy and strength essential for rapid work to close limits. To secure accuracy, the ways and flat bearings are scraped to master plates; spindle bearings are ground and lapped; work centers are aligned with the utmost care. Every part of these machines conforms to high standards of precision.

The strength of Brown & Sharpe Grinding Machines keeps them accurate under the stresses of constant production. The sturdy bed gives firm support to the table and wheel slide. Directly below the point where the wheel and work meet, a wall of metal extends clear to the floor. This wall resists the wheel's downward thrust and helps to secure greater accuracy in the finished work.

Strength and accuracy are features of Brown & Sharpe Machines which you should consider when purchasing grinding equipment. Write today for further information about these machines.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

Use BROWN & SHARPE MACHINES *for Production*





The frames of Rex Micrometers are of I-section to give the greatest rigidity and strength with lightness. The rectangular shape of the frame gives greater measuring capacity than frames of the circular type. Supply your tool cribs with Rex Micrometers.

For uniform results on ground work use Rex Micrometer Sets

A set of reliable micrometer calipers is indispensable in the modern grinding room. For the average work found in grinding rooms we call particular attention to Brown & Sharpe Rex Micrometer Set No. 135, containing 6 micrometers measuring from 0 to 6″. These are strong, light, accurate tools, each furnished with a Clamp Ring —ideal micrometers for measuring ground work.

The constant use to which micrometers are subjected in the grinding room requires just such dependable tools as are found in Rex Sets. Made with the world-known Brown & Sharpe accuracy, Rex Micrometers will help maintain the uniform quality of your ground work. Supply your grinding room with one or more Rex Micrometer Sets.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.



The booklet "New Tools by Brown & Sharpe" will be sent with every copy of our No. 28 Catalog. Six Rex Sets and many other new tools are fully described in this booklet. Write today, asking for Catalog No. 28.

Use BROWN & SHARPE TOOLS

for Accurate work

PERSONALS

ERNEST W. DUSTON, formerly of Cleveland, Ohio, is now chief engineer of the American Bolt Corporation, New York.

CALVIN L. JONES, welding engineer of the Westinghouse Electric & Mfg. Co., at Atlanta, Ga., has been elected vice-president of the American Welding Society.

GEORGE H. GRUNDY has been made manager of steel sales for Peter A. Frasse & Co., Inc., with headquarters at the general offices of the company in New York City.

H. M. CRANE, consulting engineer, 44 W. 44th St., New York, has been nominated to serve as president of the Society of Automotive Engineers for the next administrative year.

WILLIAM BREEDEN, formerly general manager of sales of the Lackawanna Steel Co., has been made manager of steel sales in the Buffalo district for Peter A. Frasse & Co., Inc., with offices at 52 Exchange St., Buffalo.

JAMES C. BENNETT, comptroller of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., was elected a director of the company at a recent meeting of the stockholders in place of John R. McCune, who died on May 14.

WALTER ROGERS, until recently connected with the Taft-Peirce Mfg. Co., Woonsocket, R. I., returned July 1 to the Vonnegut Machinery Co. of Indianapolis, Ind., to take charge of the accessory department of that company.

J. R. VIETS, for many years in charge of the shipping department of the General Electric Co.'s Lynn works, and more recently traffic representative for the New England district, has been appointed assistant traffic manager with headquarters at River Works, West Lynn, Mass.

L. R. LOUIS has resigned his position as vice-president and sales manager of the Cleveland Cap Screw Co., formerly known as the F. P. Screw Co., of Cleveland, Ohio. Previous to his connection with this company he was assistant sales manager for the Foster Bolt & Nut Mfg. Co., also of Cleveland.

PROFESSOR HAROLD A. THOMAS, for the last thirteen years a member of the staff of the Rose Polytechnic Institute, Terre Haute, Ind., has joined the faculty of the Carnegie Institute of Technology for the coming year. He will begin his new work in the fall as professor of theoretical hydraulics and of hydraulic and sanitary engineering.

A. S. MOODY, assistant northwest manager of the General Electric Co., Schenectady, N. Y., has been appointed local manager of the Los Angeles office of the company, to succeed R. L. Cash, who has been transferred to Schenectady. Mr. Moody has been identified with the General Electric Co. on the Pacific Coast for the last sixteen years.

R. B. HUBBELL, formerly connected with the Norton Co. and the Heald Machine Co., Worcester, Mass., is now in charge of machine tool sales with the Greenfield Tap & Die Corporation, Greenfield, Mass. Mr. Hubbell has had many years of experience in the manufacture and selling of machine tools, particularly in the grinding field.

GEORGE G. EVERITT, for eleven years associated with the Whitman & Barnes Mfg. Co.'s eastern sales organization in New York, has been made manager of the New York office and warehouse, at Church and Chamber Sts., New York City. Mr. Everitt's previous experience has given him a wide knowledge of the twist drill and reamer requirements in this territory.

THOMAS H. ENDICOTT has been appointed vice-president and general manager of the Green Equipment Corporation, Monadnock Block, Chicago, Ill., manufacturer of commutator under-cutting tools, and commutator stones and cements. Mr. Endicott was formerly sales engineer with the Crocker-Wheeler Co., and later sales manager for the metal-cutting department of E. C. Atkins & Co.

W. J. LEIGHNER has been appointed works manager of the George Cutter Co., a subsidiary of the Westinghouse Electric & Mfg. Co., located at South Bend, Ind. Mr. Leighner has been in the employ of the Westinghouse company since 1903, having advanced step by step through the positions of errand boy, drawing-room attendant, follow-up clerk, order clerk, chief clerk of the railway department, and assistant supervisor of production, until he has reached the position of works manager.

WILLIAM C. FRYE, for seven years president of the Chain Belt Co., Milwaukee, Wis., and for twenty-eight years associated with the company, has retired from active participation in its affairs, and has been succeeded by C. R. Messinger who held the positions of vice-president and general manager since 1917. Mr. Messinger is also president of the Interstate Drop Forge Co., vice-president of the Sivyer Steel Casting Co., and vice-president of the Federal Malleable Co., all of Milwaukee, as well as a director in the Nugent Steel Castings Co., of Chicago.

OBITUARIES

J. HARRY KITT, for many years traffic manager for the Carborundum Co., Niagara Falls, N. Y., died Thursday, July 19, at his home in that city, aged fifty-seven years.

WALTER M. AIKMAN, an outstanding figure in the stamping, enameling, and galvanizing business, died July 6 at his home in Greenwich, Conn., in his ninety-sixth year. At the time of his death he was chairman of the board of directors of the Central Stamping Co. of New York and Newark, N. J., with whom he had been connected for nearly seventy-seven years. Mr. Aikman was born in New York on April 6, 1828, and at the age of nineteen began his career in the sheet metalware industry with the firm of N. A. James & Co., which was established in 1834. At the end of the second year, he became a partner of the firm, and upon the death of N. S. James, the concern became James, Aikman & Co. The company later consolidated with E. Ketcham & Co., and in 1886, when the name Central Stamping Co. was assumed, Mr. Aikman became president, which office he held until 1922, when he became chairman of the board of directors. He is survived by two daughters and a son.

IMPROVEMENT IN BRITISH BUSINESS CONDITIONS

A general but slow improvement in European business conditions is predicted by Brudenell P. Boyle, assistant to the European manufacturer of the Westinghouse Electric International Co., London, England, who is in this country on a brief business trip. Mr. Boyle has been in the export business for many years, and is quite familiar with world affairs. He states that the general tone in England is toward stability; that people are making up their minds to take things as they are and make the most of them; and that the increase in stability and confidence is reflected in the present building boom in England. The building industry is the only one that is showing real signs of activity, but it is bringing the steel and electric industries along. The situation in England is, therefore, much like that in this country, where building activity led to the return of better industrial conditions, and where the electric power companies have for some time been increasing their capacity, to take care of the increase in business resulting from increased building activity.

* * *

THE RAILROAD SITUATION

The railway earnings for the last few months are the best on record for many years. The freight loadings are the highest in the history of the railroads, and owing to the large number of freight cars added to the equipment, there is a surplus of cars in good repair. In October, 1920, when 1,018,500 freight cars were loaded in one week—the highest previous loading record—there was a car shortage of nearly 70,000 cars. During the last week in June, 1,021,800 cars were loaded, and there was a surplus of 63,600 cars in good repair. This is due to the fact that 248,000 freight cars have been ordered since January 1, 1922, of which about 140,000 have been delivered. In the same period 4250 locomotives have been ordered, of which about 2000 are still to be delivered. The railroads are making great strides in providing sufficient equipment to handle the increased traffic that is being offered by the expanding industries.

* * *

INDUSTRIAL LABOR CONDITIONS

Employment in the manufacturing industries has remained fairly constant during the last six months. In most of the machine-building centers there has been a shortage of skilled labor. Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association points out, however, that there is really enough labor available for a steady production, and that the apparent labor shortage is mainly due to the fact that some manufacturers assume that if they can get sufficient labor, they can turn out the orders that they are able to obtain in what amounts to a boom period, even though most other manufacturers cannot do so. This practice merely brings about an increase in wages without increasing the total supply of goods or orders for goods, and causes increases in costs and prices, thereby doing a great deal of harm to both the industry and the community.

The Adaptable—

CINCINNATI VERTICAL MILLER

"A Good Way to Mill a Spiral"

Note that the only special part of the equipment is a small bracket fastened to the end of the plain table for supporting the intermediate change gears. It is a simple task to connect the standard rotary table drive with the plain table screw by means of change gears. For every revolution of the rotary table the plain table is advanced a distance of 1.25″ which was the lead of the spiral.

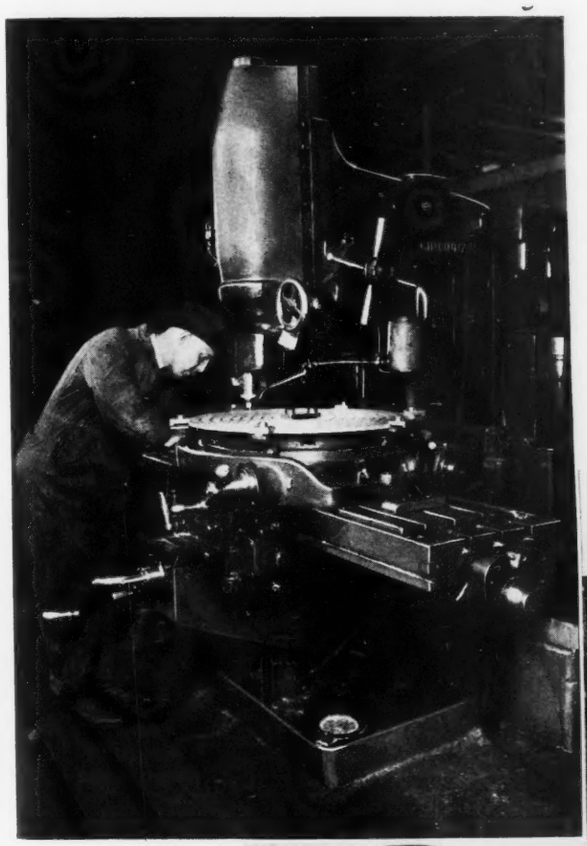
A standard high speed milling attachment added to the regular head gave the necessary speed to the small cutters required for the job.

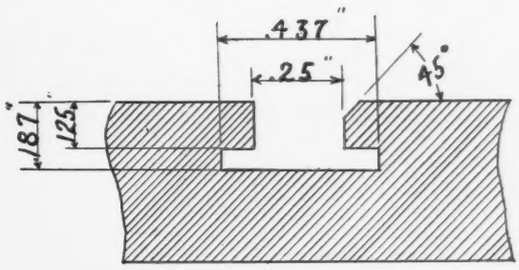
The piece is an aluminum disc 28″ outside diameter, 7/16″ thick, with a spiral T-slot that makes 8 revolutions at a lead of 1.25″.

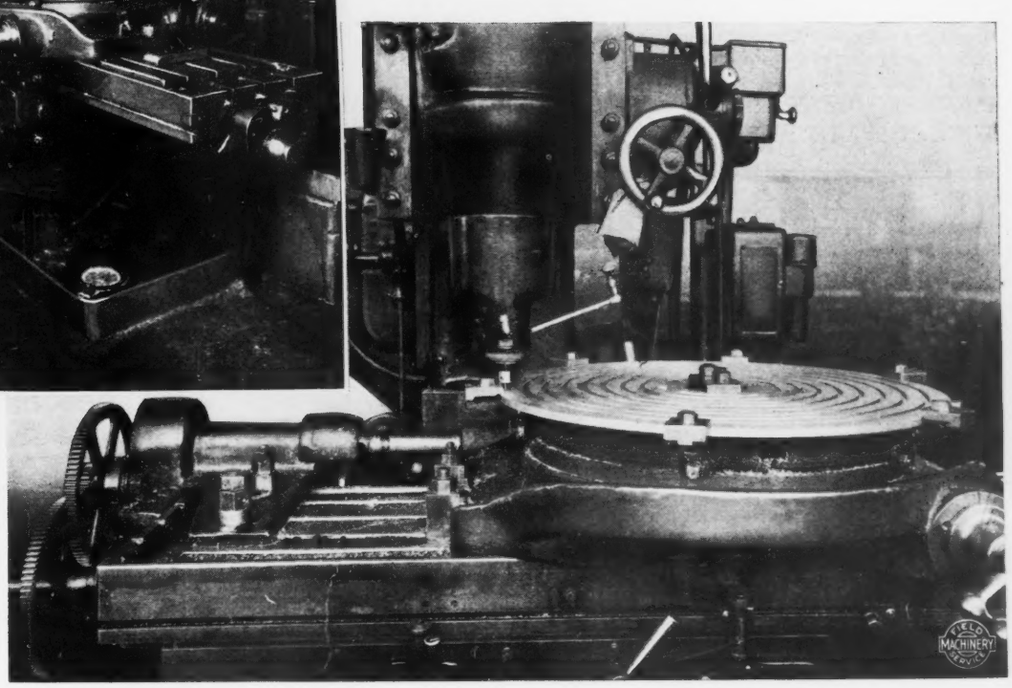
This handling of an unusual job is a good example of the adaptability of the Cincinnati Vertical Milling Machine. We'll be glad to show you other examples.

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U. S. A.







TRADE NOTES

MANNING, MAXWELL & MOORE, INC., has moved its offices to the Pershing Square Building, 100 E. 42nd St., New York City.

LATROBE TOOL CO., Latrobe, Pa., manufacturer of high-speed drills and reamers, has moved its Chicago warehouse to 1440 W. Lake St.

V & O PRESS CO., manufacturer of presses, dies, and special machinery, is now located in its new plant at Hudson, N. Y., to which all mail should be addressed.

VANADIUM ALLOYS STEEL CO. announces that its Pittsburg sales office will be removed September 1 from its present location at First and Ross Sts. to the Oliver Bldg., Pittsburg, Pa.

COLONIAL SUPPLY CO., Pittsburg, Pa., has been appointed exclusive distributor in the western Pennsylvania territory for the Latrobe Tool Co., Latrobe, Pa., manufacturer of high-speed drills and reamers.

AMERICAN NICKEL CORPORATION, Clearfield, Pa., has discontinued the Pittsburg sales office formerly maintained, and has moved its entire sales organization to the main office and plant at Clearfield, Pa.

ROCKFORD TOOL CO., 2400 Eleventh St., Rockford, Ill., has appointed the Foss Machinery Co., 305 St. James St., Montreal, Canada, exclusive representative for the Sundstrand tool-room, manufacturing, and engine lathes in the Montreal territory.

WILLIAMS, WHITE & CO., Moline, Ill., announce that J. B. Hill has taken charge of the sale of the company's machinery in the Detroit district, succeeding C. G. d'Ugglas who recently died. Mr. Hill's office will be located at 623 Majestic Bldg., Detroit, Mich.

MANHATTAN MACHINE & TOOL WORKS, 40 Market Ave., N. W., Grand Rapids, Mich., has been purchased by Frank J. Jarecki, and the business will be continued at the same location under the name of JARECKI MACHINE & TOOL CO., manufacturing tools, dies, special machinery, screw presses, and grinders.

KENDELL MOTOR PRODUCTS CO., Fort Wayne, Ind., has been formed to take over the patent rights and business of the KENDELL ENGINEERING CORPORATION. The new company will continue the manufacture of the Kendell piston-rings, for which the old company had approximately 250 domestic and foreign distributors and dealers.

PRYIBIL-GENZLINGER MACHINE CO., manufacturer of spinning lathes, all-ball-bearing wood turning lathes, as well as accessories, such as oval spinning chucks, trimming and beading attachments, and compound leather spinning attachments, formerly situated in the Herald Bldg., New York City, is now located at 22-26 Frost St., Brooklyn, N. Y.

ROLLER-SMITH CO., 233 Broadway, New York City, has appointed H. D. Baker, 525 Woodward Ave., Detroit, Mich., representative of the state of Michigan for its line of instruments, circuit breakers, and radio apparatus. Mr. Baker has been associated with the Roller-Smith Co. in various capacities for several years.

CHICAGO BELTING CO., 127 N. Green St., Chicago, Ill., announces that it is now represented in the Memphis and Vicksburg territories by the J. E. Dilworth Co., Inc., 493 S. Main St., Memphis, Tenn., who will have the exclusive distribution of Chicago leather belting in this district. The J. E. Dilworth Co., Inc., will carry a complete stock of "Reliance" and "Sea Lion" leather belts, in addition to the Chicago line of belting accessories and special belts.

GODDARD & GODDARD CO., INC., Detroit, Mich., manufacturer of milling cutters, recently held its yearly gathering of representatives and salesmen at the home office, under the supervision of C. S. Goddard, sales manager. L. K. Berry, sales manager of the Detroit Twist Drill Co., and A. N. Goddard, president of Goddard & Goddard Co., gave the principal addresses. One of the features of the meeting was a tour through the plant of the Hudson Motor Car Co.

ELK MFG. CO., New York City, has been taken over by the ELK MACHINE TOOL CORPORATION, 243 W. 17th St., New York City. The new company will continue to manufacture and sell all the precision tools formerly made by the Elk Mfg. Co. under the Elkin patents, including machines for shaving, burnishing, and squaring bearings used in internal combustion motors, valve-lifters, air compressors, etc. J. G. Elkin is president of the company and will have entire charge of manufacturing.

CONNECTICUT BLOWER CORPORATION, Hartford, Conn., has been incorporated under the laws of Delaware, with a capitalization of $250,000, to manufacture blowers and exhaust fans, blower systems of all kinds, dust collecting systems, etc. The new company will take over the business of the INTERNATIONAL BLOWER CO. and the HARTFORD SHEET METAL WORKS. The plant of the former company will be utilized until the fall, at which time a larger plant will be occupied. The officers of the company are as follows: President, M. E. Keeney; treasurer, C. H. Keeney; and secretary, C. E. Keeney.

BLAKELY MFG. CO., Detroit, Mich., has purchased the stamping machinery and equipment of the LIBERTY STAMPING & MFG. CO., and is removing this equipment to its new factory at Fullerton Ave. and Monnier Road. The company manufactures shipping fastenings, particularly hold-downs of various kinds for automobiles. A new line of fastenings is being brought out, which is adapted to the general manufacturing trade for holding parts in position in crates, boxes, or freight cars. The Liberty Stamping & Mfg. Co. will concentrate its efforts in the future on the manufacture and sale of its line of enameled metal tables.

BRIGHTMAN BROS. CO., Columbus, Ohio, is a new organization incorporated for $250,000 to engage in the manufacture of hexagon steel bar nuts, shafting machinery, and straightening machinery. It is intended later to install equipment for manufacturing turned and drawn shafting, screw stock, and cold-drawn products. Land has been purchased between Markinson and Woodrow Aves., in South Columbus, on which a plant will be erected which is expected to be in operation in about two months. The officers of the company are as follows: President, C. W. Brightman; vice-president and treasurer, G. F. Brightman; vice-president, H. M. Brightman; secretary, H. L. Brightman, and assistant secretary, T. L. Brightman. All of the officers were formerly connected with the Brightman Mfg. Co., of Columbus, and were among the originators of the Brightman process for turning shafting.

COMING EVENTS

August 20-30—Meeting of the American Institute of Mining and Metallurgical Engineers at Quebec, Canada. Secretary, F. F. Sharpless, 29 W. 39th St., New York City.

September 17-22—Ninth national exposition of chemical industries, in the Grand Central Palace, New York City. For further information address National Exposition of Chemical Industries, Grand Central Palace, New York.

September 18-21—Third annual machine tool exhibit given by the New Haven branch of the American Society of Mechanical Engineers in the Mason Laboratory, New Haven, Conn. Chairman, A. C. Jewett.

September 24-28—Meeting of the Association of Iron and Steel Electrical Engineers at Buffalo, N. Y., in conjunction with the Iron and Steel Exposition held in the Buffalo Auditorium. Further information may be obtained from the Association of Iron and Steel Electrical Engineers, Empire Building, Pittsburg, Pa.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

October 25-26—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Further information may be obtained from the society's headquarters, 29 W. 39th St., New York City.

October 29-31—Convention of the American Management Association in New York City; headquarters, Hotel Astor. Further information can be obtained from the secretary of the association at 20 Vesey St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Delaware, Newark, Del. Catalogue for 1922-1923 containing calendar, description of courses, and general information concerning registration, fees, etc.

Polytechnic Institute of Brooklyn, Livingston and Court Sts., Brooklyn, N. Y. Catalogue of the College of Engineering for 1923-1924, containing calendar, requirements for admission, outline of courses, and other information relative to the institute.

Pennsylvania State College, State College, Pa. Circular containing announcement of the eighth summer session in industrial organization and administration, which is held from August 27 to September 8. The circular gives information regarding the course, and shows views in the various departments.

NEW BOOKS AND PAMPHLETS

Methods of Measurement of Properties of Electrical Insulating Materials. By J. H. Dellinger and J. L. Preston. 72 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 471 of the Bureau of Standards. Price, 15 cents.

Patent Worth and Worthless Patents. By Thomas A. Hill. 48 pages, 5 by 7 inches. Published by the Davie Press, Inc., 267 W. 17th St., New York City.

The reason for the preparation of this book, states the author in the preface, is that comprehensive text-books on patent law are necessarily voluminous and cannot be fully appreciated without some preliminary study of law; therefore, there seems to be a need for a book that tells, plainly, something about both what is of value and what is worthless in connection with patents.

Construction and Use of Automatic Screw Machines. 352 pages, 6 by 9 inches. Published by the Brown & Sharpe Mfg. Co., Providence, R. I. Price, $1.

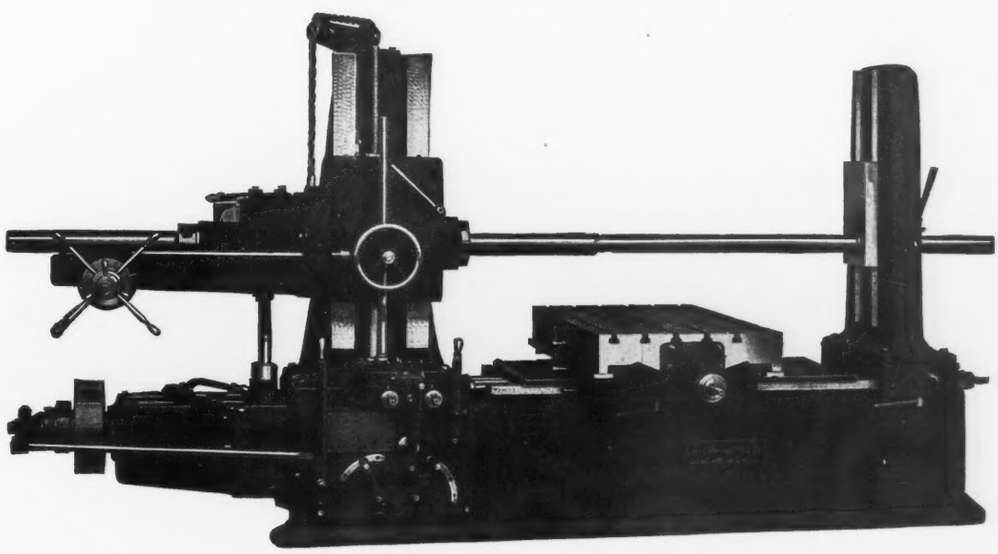
This book has been prepared by the Brown & Sharpe Mfg. Co., as a book for the operator of the automatic screw machines built by the company, and also deals with automatic turret forming machines and automatic cutting-off machines. It is divided into nine chapters, dealing, respectively, with a general explanation of how the

We could say many good things about the LUCAS

"PRECISION"

BORING, DRILLING AND

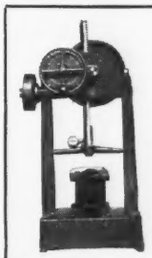
MILLING MACHINE



But it is what the users say that counts; and here is what one of them DID say:

"When any one asks to see our Lucas, we take him over to the machine, take off our hats, and say, 'there it is.'"

And we have a large collection of "customer's ads" almost as good.



WE ALSO MAKE THE

LUCAS POWER Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo. Aux Forges de Vulcain, Paris. Benson Bros., Sydney, Melbourne.

Brown & Sharpe automatic screw machines operate, the erection and care of the machine, how to set up a machine for a job, the construction and adjustment of the machine, the standard tools used, the automatic turret forming and cutting-off machines, how to design cams, how to machine cams, and attachments. A number of tables and a complete index are also included. The book contains numerous illustrations pertaining to the different subjects dealt with. All parts are clearly shown, and the text is simple and to the point.

Design of Steam Boilers and Pressure Vessels. By George B. Haven and George W. Swett. 435 pages, 6 by 9 inches; 206 illustrations. Published by John Wiley & Sons, Inc., New York City. Price, $4.

This is the second edition of the author's well-known book on steam boilers and pressure vessels. The book is intended primarily to teach rational methods of boiler design, but at the same time it serves as an introduction to a broader study of machine design. The application of the principles set forth at the beginning of the book is ably illustrated in the last six chapters by working out from beginning to end complete designs for boilers and tanks of six different types. The book comprises ten chapters as follows: General Principles; Stresses in Pressure Vessels; Fastenings by Riveted Joints; General Proportions; Design of a Horizontal Return Tubular Boiler; Design of a Dry Back Scotch Boiler with Combustion Chamber in Shell Extension; Design of a Vertical Straight Shell Multi-tubular Boiler; Design of a Locomotive Type Boiler for Contractors' Use; Tank Design; and Water-tube Boiler Design.

Locomotive Catechism. By Robert Grimshaw. 958 pages, 5 by 7½ inches; 500 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $4.

This is the thirtieth revised and enlarged edition of a unique book on the design, construction, running and repairing of all kinds of locomotives, including information on air brakes, superheaters, the Walschaert valve gear, etc. The present edition contains over 4000 questions and answers. The catechism form in which the book is published makes it especially valuable in preparing for examinations. Some of the questions included are those used by prominent American railways in examining firemen and engineers for employment and promotion. In the present edition special attention is paid to certain branches more recently brought to the engine-runners and fireman's notice—for instance, the unaflow engine, the improved superheater, the latest design of power brake, and the electric locomotive. The chapter on accidents has been enlarged, and material has been added on valve diagrams, traction curves, and motion studies.

NEW CATALOGUES AND CIRCULARS

Findlay Engineering & Mfg. Co., Findlay, Ohio. Circular containing illustrations and specifications for the models A and B riveters produced by this firm.

Goulds Mfg. Co., Seneca Falls, N. Y. Bulletin illustrating the construction of the Goulds new line of single-stage, double-suction centrifugal pumps.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheet No. 154 FE describing the application of New Departure ball bearings in a variable-speed hydraulic transmission.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Booklet known as Special Publication No. 1667, containing a list of over 300 installations of Westinghouse industrial heating apparatus.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., is supplying belt users, upon request, with belt record cards, 5 by 8 inches in size, for keeping a record of the performance of belts of different kinds and sizes.

Pryibil-Genzlinger Machine Co., 26 Frost St., Brooklyn, N. Y. Circular illustrating and describing ball-bearing metal-spinning lathes for round and oval work. The circular gives full specifications and dimensions.

L. Best Co., 28-30 West Broadway, New York City. Supplementary catalogue (1923) of Sterling grinding wheels of different types, including vitrified, silicate, and elastic wheels of all the commercial grades and grains.

Crescent Tool Co., Jamestown, N. Y., is issuing a monthly publication called "The Crescent," published by and for the employes, which contains personal items and other news of the social activities of the organization.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular showing applications of the "Liftabout" electric hoist, a small, easily installed hoist adapted for moving both large and small loads in all lines of work.

Latrobe Tool Co., Latrobe, Pa. Catalogue for 1923, covering the line of high-speed twist drills and reamers made by this concern. Tables of dimensions and list prices are given for each of the tools, and illustrations are included.

Affa Specialty Co., 34 Southbridge St., Worcester, Mass. Circular containing facts about the Affa pressed-steel C-clamp for machinists and toolmakers, which is claimed to give a pressure of 175 pounds when screwed up with the fingers only.

Mahr Mfg. Co., Minneapolis, Minn. Circular descriptive of the Mahrvel oil-fired compressed-air tool furnace, for hardening, drawing, and annealing high-speed or carbon steels and similar work. Specifications are given for four different sizes of furnaces.

Consolidated Tool Works, Inc., 296 Broadway, New York City. Circular illustrating the No. 26 heavy-handle adjustment hacksaw frame manufactured by this concern. The frame is made of heavy steel construction, and is adjustable for 8- to 12-inch blades.

Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin 3044, descriptive of Imperial type XPV duplex steam-driven air and gas compressors, equipped with Ingersoll-Rand plate air valves. These air compressors are made in a number of different types and sizes.

Wisconsin Electric Co., 2562 Sixteenth St., Racine, Wis. Circular showing "Dumore" high-speed grinders in use on a variety of work. These grinders are portable, electrically driven, and are made in six distinct styles with different speed ranges for various classes of work.

Crescent Washing Machine Co., New Rochelle, N. Y. Circular entitled "Washing Metals by Machinery," containing illustrations and specifications of the line of metal cleaning machines made by this concern, which utilizes both chemical and mechanical action in cleaning metal parts.

Westcott Chuck Co., Oneida, N. Y. Catalogue 510, covering the Westcott line of lathe chucks and Little Giant drill chucks. Dimensions and prices are given for the four different styles of drill chucks and the six styles of lathe chucks produced by this firm. The various styles of chucks are illustrated.

Brown Instrument Co., Philadelphia, Pa. Booklet entitled "The Automatic Control of Temperature in the Heat-treating of Steel," containing illustrations and descriptions of Brown automatic control pyrometers, illustrations of installations, and statements from users in regard to their experience with this equipment.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has issued the first number of a publication devoted to industrial heating, which is entitled "Electric Heat." This number contains articles concerning the use of electric heat in the manufacture of storage batteries and electric motors, as well as many other applications.

Johns-Pratt Co., 41 E. 42nd St., New York City, has issued a locomotive chart for the use of engineering and mechanical departments of steam railroads. The chart shows a typical modern locomotive in outline, with each part numbered, and gives a complete list of the parts numbered, with a definite reference to defects as covered by the Interstate Commerce Commission rulings.

Motorbloc Corporation, Summerdale, Philadelphia, Pa. Bulletin L25, illustrating and describing the Motorbloc motor-driven chain hoist intended for a wide range of material-handling operations. Bulletin L50, containing instructions for maintaining the Motorbloc motor-driven chain hoist. This bulletin contains a general description of the hoist, oiling directions, and a list of parts.

W. S. Rockwell Co., 50 Church St., New York City. Circular describing the relation of furnace temperature control to the quality and cost of the finished product. The circular will aid in giving a better understanding of the underlying principles affecting the manner, rate, and time of heating, which must be considered, in addition to temperature regulation, in determining the uniformity with which a product is heated or cooled.

Yale & Towne Mfg. Co., Stamford, Conn. Folder on the new Yale trolleys, containing, in addition to detailed descriptions of the plain and geared types of Yale steel plate roller bearing trolleys, a description of the new Yale cast-iron trolley. Details are given of some tests to which the steel plate trolley has been subjected, as well as a complete list of the material-handling equipment manufactured by this company.

Edwin E. Bartlett, Nashua, N. H. Circular entitled "Questions Answered Regarding Greenerd Arbor Presses," containing information concerning the construction of these arbor presses. Circular illustrating Greenerd arbor presses, which are made in thirty different styles and sizes. This circular also gives a table of pressure factors for different shaft diameters, used in determining the size of arbor press to be used. The Greenerd arbor presses are sold by Henry Prentiss & Co., 149 Broadway, New York City.

Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Circular illustrating some of the special single-purpose types of riveters made by this concern to suit a wide variety of conditions. A brief description is given in connection with the different styles of the particular work for which each is applicable. The regular line of Hanna riveters is made in 500 styles and sizes, ranging from 4 inches to 21 feet reach, with capacities of from 10 to 150 tons.

Rollway Bearing Co., Inc., Syracuse, N. Y. Catalogue 3, containing a general description and tables of dimensions, load ratings, speeds, etc., of the Rollway "Maximum" type bearings, which are designed for use under the most severe type of service. The original range of sizes has been increased so as to afford a proper selection for practically any condition. Data are included on the Rollway thrust bearings which are also designed for severe work.

Mitchell Engineering Co., Springfield, Ohio. Catalogue illustrating and describing the line of ball-bearing polishing and buffing machines made by this concern. Two styles of machines are shown, single- and double-spindle machines, and specifications are given for the different sizes in both styles. One of the special features claimed for this line of machines is the rapidity with which the spindles can be removed and replaced, thus eliminating lengthy shutdowns and delay in production.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Pamphlet descriptive of the course in vocational training offered by this company, the purpose of which is to train students to become skilled mechanics. Class-room instruction and practical shop work are carried on at the same time, and the boys are earning a wage doing actual production work, while acquiring their training. A complete account of the course is given, and the illustrations show the attractive environment with which the boys are surrounded.

Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin 63, illustrating and describing Niagara straight-sided single-crank power presses, series No. 50, and trimming presses, series No. 50-T. Bulletin 64, descriptive of Niagara double-crank power presses, series No. 60. Bulletin 65, illustrating and describing Niagara double-crank power presses, series No. 70. These bulletins contain detailed descriptions, and clear and distinct illustrations of the various types of presses manufactured by the company, as well as information relative to modifications of design and special features.

Brown & Sharpe Mfg. Co., Providence, R. I. Booklet on Brown & Sharpe ground-form cutters, which have been developed with a view to obtaining work of a high degree of accuracy, increasing production, and securing cutter economy. The booklet describes in detail the important features of these cutters. The principle of the ground-form cutter is confined to cutters of comparatively simple outlines, such as those for cutting gears, sprockets, and spline shafts, and the advantages of this form of cutter for each of these classes of work are pointed out.

Hanchett Swage Works, Big Rapids, Mich. Folder illustrating and describing the Hanchett portable combination woodworker, which consists of a universal saw, a planer, and a drum sander. This combination makes it possible to perform all the most common woodworking operations on one machine. The pedestal is mounted on rollers, and fitted with a roller jack which locks the machine in a stationary position or lifts it and allows it to be rolled to the place where the work is to be performed. The machine is approximately 35 inches high, and weighs about 500 pounds; the size of the combined work-table top is 24 by 33 inches.

Norton Co., Worcester, Mass. Handbook on tool and cutter grinding, and catalogue of Norton universal tool and cutter grinding machines. The book contains considerable general information on the subject of tool and cutter grinding, including the selection of wheels and grinding procedure. An interesting feature of the book is the section containing problems in tool and cutter grinding, which gives data on equipment to be used, preliminary preparation, methods of setting up and grinding a wide variety of work. While these problems are especially applicable to Norton machines, they may also be adapted to other makes. Pamphlet giving information on grinding wheels, covering selection of grain and grade, wheel faces, how to order, testing for safety, methods of mounting, and wheel speeds.

Wells Corporation, Greenfield, Mass. Catalogue 1, of standardized small tools, superseding all other small tool catalogues formerly issued by the constituent companies of this corporation, namely, the Frank O. Wells Co., American Tap & Die Co., and the Williamsburg Mfg. Co. The catalogue gives dimensions and list prices of screw plates, taps, dies, die-stocks, tap wrenches, die-holders, reamers, counterbores, keyway sets, broaches, broaching presses, hacksaw frames, tool sets, screwdrivers, levels, nail sets, center-punches, etc. Attention is called to the fact that this catalogue includes only sizes and sets of tools that are in constant demand, and only such screw threads are shown as are recommended by the National Screw Thread Commission and the committee appointed by the American Society of Mechanical Engineers. The aim in thus standardizing the tools shown in this catalogue is to reduce the number of unnecessary sets, styles, and sizes, thus reducing waste and incidentally prices.



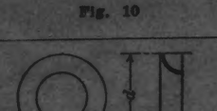
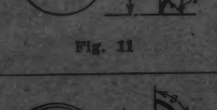
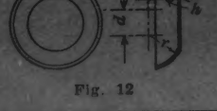
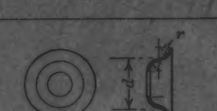
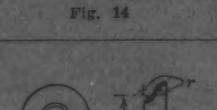
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PUNCH PUNCH

AREAS OF DRAWN SHELLS

Segment of Shell	General Rule	Formula
 Fig. 1	Area equals area of circle of diameter d, minus area of circle of diameter d_1.	$\text{Area} = \frac{\pi(d^2 - d_1^2)}{4}$
 Fig. 2	Area equals numerical value of circumference of circle of diameter $2rh$ or sum of areas of two circles of diameters d and $2h$.	$\text{Area} = 2\pi rh$ or $\text{Area} = \pi\left(\frac{d^2}{4} + h^2\right)$
 Fig. 3	Area equals sum of areas of two circles of diameters d_1 and $2h$.	$\text{Area} = \pi\left(\frac{d_1^2}{4} + h^2\right)$ $h = r - \sqrt{r^2 - \frac{d^2}{4}}$
 Fig. 4	Area equals twice area of circle of diameter $2r$.	$\text{Area} = 2\pi r^2$
 Fig. 5	Area equals numerical value of circumference of circle of diameter $2rh$.	$\text{Area} = 2\pi rh$
 Fig. 6	Shape of shell does not permit of a simple rule.	$\text{Area} = 2.222\, d\sqrt{h^2 + \frac{d^2}{4}}$
 Fig. 7	Area equals numerical value of circumference of circle of diameter dh.	$\text{Area} = \pi dh$
 Fig. 8	Area is numerically equal to circumference of circle of diameter $f\left(\frac{d + d_1}{2}\right)$.	$\text{Area} = \pi f\left(\frac{d + d_1}{2}\right)$ $f = \sqrt{h^2 + \left(\frac{d_1 - d}{2}\right)^2}$

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PUNCH PUNCH

AREAS OF DRAWN SHELLS—CONTINUED

Segment of Shell	General Rule	Formula
Fig. 9	Area equals numerical value of circumference of circle of diameter $2rh$.	$\text{Area} = 2\pi rh$
Fig. 10	Area equals product of circumferences of two circles of diameters r and $\frac{d}{2}$, plus twice area of circle of diameter $2r$.	$\text{Area} = 2\pi r^2 + \frac{\pi^2 rd}{2}$
Fig. 11	Area equals product of circumferences of two circles with diameters of r and $\frac{d}{2}$ minus twice area of circle of diameter $2r$.	$\text{Area} = \frac{\pi^2 rd}{2} - 2\pi r^2$
Fig. 12	Area equals numerical value of circumference of circle having a diameter of $(ds + 2rh)$.	$\text{Area} = \pi(ds + 2rh)$
Fig. 13	Area equals numerical value of circumference of circle having a diameter of $(ds - 2rh)$.	$\text{Area} = \pi(ds - 2rh)$
Fig. 14	Area equals product of circumferences of two circles of diameters d and r, respectively.	$\text{Area} = \pi^2 rd$
Fig. 15	Area found by rule given for Fig. 14.	$\text{Area} = \pi^2 rd$

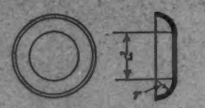
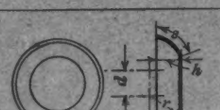
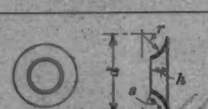
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AREAS OF DRAWN SHELLS—CONTINUED

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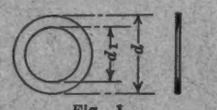
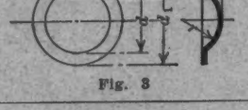
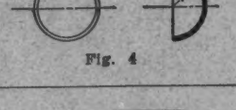
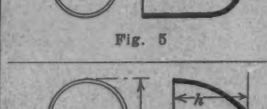
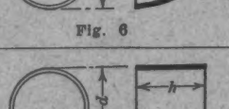
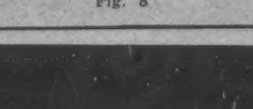
MACHINERY'S Data Sheet No. 2, New Series, January 1923

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MACHINERY'S Data Sheet No. 1, New Series, January 1923

PUNCH PUNCH

AREAS OF DRAWN SHELLS

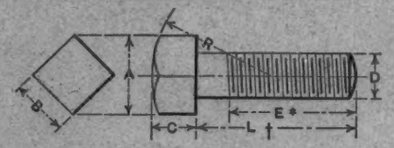
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MACHINERY'S DATA SHEETS Nos. 1 and 2

CUT OUT ON THIS LINE

DIMENSIONS OF CAP-SCREWS

SQUARE-HEAD CAP-SCREWS—1

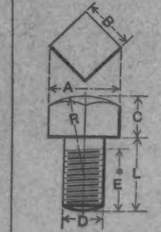


Outside Diameter of Screw, D	Number of Threads per Inch	National Acme Co.; Hartford Mach. Screw Co.; Nat. Screw & Tack Co. A	National Acme Co.; Hartford Mach. Screw Co.; Nat. Screw & Tack Co. B	Nat. Acme Co.; Nat. Screw & Tack Co. C	Hartford Machine Screw Co. C	National Acme Co. R	Hartford Machine Screw Co. R	National Screw & Tack Co. R
¼	20	17/32	3/8	¼	7/32	25/32	3/4	½
5/16	18	5/8	7/16	5/16	9/32	15/16	7/8	5/8
3/8	16	45/64	½	3/8	5/16	1 1/16	1	3/4
7/16	14	51/64	9/16	7/16	3/8	1 3/16	1 1/8	7/8
½	12 or 13	57/64	5/8	½	7/16	1 5/16	1 1/4	1
9/16	12	31/32	11/16	9/16	½	1 15/32	1 3/8	1 1/8
5/8	11	1 1/16	3/4	5/8	9/16	1 19/32	1 1/2	1 1/4
3/4	10	1 15/64	7/8	3/4	11/16	1 27/32	1 3/4	1 1/2
7/8	9	1 19/32	1 1/8	7/8	3/4	2 3/8	2 1/4	1 3/4
1	8	1 49/64	1 1/4	1	7/8	2 21/32	2 1/2	2
1 1/8	7	1 15/16	1 3/8	1 1/8	1	2 29/32	2 3/4	2 1/4
1 1/4	7	2 1/8	1 1/2	1 1/4	1 1/8	3 3/16	3	2 1/2

* For lengths L of 4 inches or less, E equals ¾ length L; for lengths greater than 4 inches E equals ½ length L, according to a common rule.

† For minimum and maximum lengths L, see table on Data Sheet No. 3 "Commercial Lengths of Cap-screws."

SQUARE-HEAD CAP-SCREWS—2*
(Scovill Manufacturing Co.)



Outside Diameter of Screw, D	Number of Threads per Inch	Distance Across Corners, A	Width of Head, B	Thickness of Head, C	Radius of Head, R
¼	20	27/64	19/64	¼	½
5/16	18	9/16	13/32	5/16	5/8
3/8	16	21/32	15/32	3/8	3/4
7/16	14	47/64	17/32	7/16	7/8
½	13	7/8	5/8	½	1
9/16	12	15/16	43/64	9/16	1 1/8
5/8	11	1	23/32	5/8	1 1/4
3/4	10	1 5/32	53/64	3/4	1 1/2
7/8	9	1 11/32	61/64	7/8	1 3/4

* Cap-screws having a length L of one inch or less are threaded up to the head. Cap-screws longer than one inch and in the following diameters and lengths, have an unthreaded portion 3/16 inch long: ¼ inch diameter up to and including 1¼ inches long; 5/16 inch diameter up to and including 1¼ inches long; ⅜ inch diameter up to and including 1¼ inches long; 7/16 inch diameter up to and including 1¼ inches long; ½ inch diameter up to and including 1⅝ inches long; 9/16 inch diameter up to and including 1⅝ inches long; ⅝ inch diameter up to and including 2 inches long; ¾ inch diameter up to and including 2½ inches long; and ⅞ inch diameter up to and including 3 inches long. When the cap-screws are longer than specified for the various diameters, the length E of the threaded portion is made one diameter less than the length L. The diameter of the plain portion is the same as that of the threaded section.

DIMENSIONS OF CAP-SCREWS

LENGTHS AND THREADS OF CAP-SCREWS

Although work on the standardization of cap-screws is now in progress, there is as yet no generally recognized standard; however, the most important dimensions of cap-screws made by different screw manufacturers in the United States are either the same or differ but slightly. The tables in this Data Sheet and in Data Sheets to be published in coming numbers of MACHINERY give proportions of cap-screws made by several prominent manufacturers, and show to what extent the dimensions vary. The length *L* (see the illustrations in the tables given in Data Sheet No. 4) indicates the nominal length of the cap-screw. This length is usually measured to the extreme point. The range of lengths in which cap-screws of different diameters are made varies, but the lengths given in the table below are listed by several manufacturers and conform closely to general practice. The amounts by which the lengths increase from minimum to maximum are as follows, according to the practice of several prominent screw manufacturers. Lengths up to 1 inch, inclusive, increase by ⅛-inch increments; lengths from 1 to 5 inches increase by ¼-inch increments.

Most cap-screws have the U. S. standard thread with thirteen threads per inch for the ½-inch diameter, although twelve or thirteen threads per inch is usually listed in the catalogues of screw manufacturers, indicating that cap-screws of ½-inch size will be cut to whichever pitch is ordered.

Machine screws and cap-screws that have heads of the same shape are unfortunately not given the same names by most screw manufacturers. Thus, for example, what is known as a "flat fillister-head" machine screw has a head of the same shape as a "round-head" cap-screw; a "round-head" machine screw has a head of the same shape as a "button-head" cap-screw; and an "oval fillister-head" machine screw is similar to a "fillister-head" cap-screw. Machine screws and cap-screws having countersunk heads are both known as "flat-head" screws. The oval-head countersunk cap-screw is often known as a "French head" cap-screw.

COMMERCIAL LENGTHS OF CAP-SCREWS

Cap-screw Diameter	Lengths of Hexagon and Square-head Cap-screws		Lengths of Fillister- and Round-head Cap-screws		Lengths of Flat- and Button-head Cap-screws	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
⅛	.....	.....	¾	2½	¾	1¾
5/32	.....	.....	¾	2¾	¾	2
¼	¾	3	¾	3	¾	2¼
5/16	¾	3	¾	3¼	¾	2½, 2¾
⅜	¾	3	¾	3½	¾	2¾, 3
7/16	¾	4	¾	4¼	¾, 1	3
½	¾	4	¾	4½	1, 1¼	3
9/16	1	4½	1	4½	1¼, 1½	3
⅝	1	4½	1¼	4½	1½, 1¾	3
¾	1¼	4¾	1½	4¾	1¾, 2	3
⅞	1½	5	1¾	5	.....	.....
1	1¾	5	2	5	.....	.....
1⅛	2	5	.....	.....	.....	.....
1¼	2	5	.....	.....	.....	.....

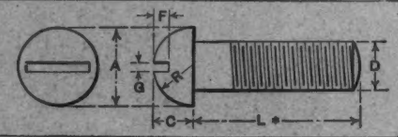
CUT OUT ON THIS LINE

CUT OUT ON THIS LINE

PUNCH O Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH O

DIMENSIONS OF CAP-SCREWS

BUTTON-HEAD CAP-SCREWS 1

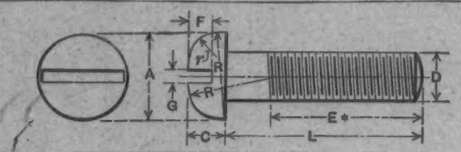


Outside Diameter of Screw, D	Number of Threads per Inch	National Acme Co. Hartford Mach. Screw Co. A	C	R	National Acme Co. F	G	Hartford Machine Screw Co. F	G
1/8	40	7/32	7/64	7/64	0.037	0.025	1/16	0.028
3/16	24	5/16	5/32	5/32	0.056	0.037	3/32	0.035
1/4	20	7/16	7/32	7/32	0.075	0.050	1/8	0.049
5/16	18	9/16	9/32	9/32	0.094	0.062	5/32	0.065
3/8	16	5/8	5/16	5/16	0.112	0.075	3/16	0.065
7/16	14	3/4	3/8	3/8	0.131	0.087	7/32	0.083
1/2	12 or 13	13/16	13/32	13/32	0.150	0.100	1/4	0.083
9/16	12	15/16	15/32	15/32	0.169	0.112	9/32	0.083
5/8	11	1	1/2	1/2	0.187	0.125	5/16	0.109
3/4	10	1 1/4	5/8	5/8	0.225	0.150	3/8	0.134

*For minimum and maximum lengths L, see Data Sheet No. 3, February 1923.

BUTTON-HEAD CAP-SCREWS—2*

(Scovill Manufacturing Co.)



Outside Diameter of Screw, D	Number of Threads per Inch	Diameter of Head, A	Thickness of Head, C	Depth of Slot, F	Width of Slot, G	Radius, R	Radius, r
1/4	20	7/16	3/16	1/8	1/16	7/16	1/8
5/16	18	35/64	15/64	5/32	5/64	35/64	5/32
3/8	16	21/32	9/32	3/16	3/32	21/32	3/16
7/16	14	49/64	21/64	7/32	7/64	49/64	7/32
1/2	13	7/8	3/8	1/4	1/8	7/8	1/4
9/16	12	63/64	27/64	9/32	9/64	63/64	9/32
5/8	11	1 3/32	15/32	5/16	5/32	1 3/32	5/16
3/4	10	1 5/16	9/16	3/8	3/16	1 5/16	3/8

*Cap-screws having a length L of 1 inch or less are threaded up to the head. For lengths greater than 1 inch, see note below table giving Scovill Mfg. Co.'s dimensions for square-head cap-screws, Data Sheet No. 4, February, 1923.

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MACHINERY'S Data Sheet No. 6, New Series, March 1923

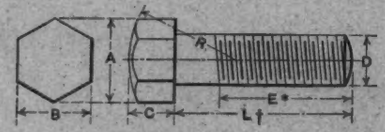
MACHINERY'S Data Sheet No. 5, New Series, March 1923

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PUNCH O Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH O

DIMENSIONS OF CAP-SCREWS

HEXAGON-HEAD CAP-SCREWS



Outside Diameter of Screw, D	Number of Threads per Inch	National Acme Co.; Scovill Mfg. Co.‡ Hartford Mach. Sc. Co.; Nat. Screw & Tack Co.; Corbin Screw Corporation A	B	Nat. Acme Co.; Scovill Mfg. Co.‡ Nat. Sc. & Tack Co.; Corbin Sc. Corp. C	Hartford Machine Screw Co. C	National Acme Co. R	Hartford Machine Screw Co. R	National Screw & Tack Co.; Scovill Mfg. Co.‡ R
1/4	20	1/2	7/16	1/4	7/32	3/4	21/32	1/2
5/16	18	37/64	1/2	5/16	9/32	7/8	3/4	5/8
3/8	16	21/32	9/16	3/8	5/16	31/32	27/32	3/4
7/16	14	23/32	5/8	7/16	3/8	1 1/16	15/16	7/8
1/2	12 or 13	55/64	3/4	1/2	7/16	1 9/32	1 1/8	1
9/16	12	15/16	13/16	9/16	1/2	1 13/32	1 7/32	1 1/8
5/8	11	1	7/8	5/8	9/16	1 1/2	1 5/16	1 1/4
3/4	10	1 5/32	1	3/4	11/16	1 23/32	1 1/2	1 1/2
7/8	9	1 19/64	1 1/8	7/8	3/4	1 15/16	1 11/16	1 3/4
1	8	1 7/16	1 1/4	1	7/8	2 5/32	1 7/8	2
1 1/8	7	1 19/32	1 3/8	1 1/8	1	2 3/8	2 1/16	2 1/4
1 1/4	7	1 47/64	1 1/2	1 1/4	1 1/8	2 19/32	2 1/4	2 1/2

*According to a common rule, the length E of the thread is determined as follows: For lengths L of 4 inches or less, $E = \frac{3}{4}$ of length L; for lengths L greater than 4 inches, $E = \frac{1}{2}$ of length L. Length L is the nominal length of the cap-screw and is measured to the extreme point.

†For minimum and maximum lengths L see Data Sheet 3, February, 1923.

‡The cap-screws listed by the Scovill Mfg. Co. vary from 1/4 to 7/8 inch in diameter, but do not include the larger diameters given in the table. According to this company's rule, lengths L of 1 inch or less are threaded up to the head. For lengths greater than 1 inch, see note below table giving Scovill Mfg. Co.'s dimensions for square-head cap-screws, Data Sheet 4, February, 1923.

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MACHINERY'S DATA SHEETS Nos. 5 and 6

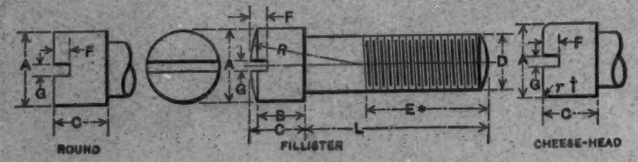
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PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

DIMENSIONS OF CAP-SCREWS

ROUND-, FILLISTER- AND "CHEESE-HEAD" CAP-SCREWS



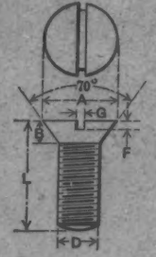
Outside Diameter of Screw, D	Threads per Inch	Nat. Acme Co.; Hartford Mach. Screw Co.		National Acme Co.			Hartford Machine Screw Co.			Nat. Acme Co., R	Hartford Mach. Screw Co., R
		A	C	B	F	G	B	F	G		
1/8	40	3/16	1/8	7/64	0.037	0.025	3/32	1/16	0.028	9/32	3/16
3/16	24	1/4	3/16	11/64	0.056	0.037	5/32	3/32	0.035	3/8	1/4
1/4	20	5/16	1/4	7/32	0.075	0.050	13/64	1/8	0.049	9/16	5/16
5/16	18	7/16	5/16	9/32	0.094	0.062	1/4	5/32	0.065	21/32	7/16
3/8	16	9/16	3/8	21/64	0.112	0.075	19/64	3/16	0.065	27/32	9/16
7/16	14	5/8	7/16	25/64	0.131	0.087	23/64	3/16	0.083	15/16	5/8
1/2	12 or 13	3/4	1/2	7/16	0.150	0.100	13/32	7/32	0.083	1 1/8	3/4
9/16	12	13/16	9/16	1/2	0.169	0.112	29/64	1/4	0.083	1 7/32	13/16
5/8	11	7/8	5/8	35/64	0.187	0.125	1/2	9/32	0.109	1 5/16	7/8
3/4	10	1	3/4	21/32	0.225	0.150	39/64	5/16	0.134	1 1/2	1
7/8	9	1 1/8	7/8	25/32	0.262	0.175	23/32	11/32	0.134	1 11/16	1 1/8
1	8	1 1/4	1	57/64	0.300	0.200	53/64	3/8	0.165	1 7/8	1 1/4

*For lengths L of 4 inches or less, E equals three-fourths of length L; for lengths greater than 4 inches, E equals one-half of length L.

†Radius r is 1/32 inch for diameters up to 1/4 inch; 3/64 inch for diameters from 5/16 to 9/16 inch; and 1/16 inch for larger diameters.

FLAT-HEAD CAP-SCREWS

(Hartford Machine Screw Co.)



Outside Diameter of Screw, D	Number of Threads per Inch	Diameter of Head, A	Depth of Head, B	Depth of Slot, F	Width of Slot, G
1/8	40	1/4	3/32	3/64	0.028
3/16	24	3/8	1/8	1/16	0.035
1/4	20	15/32	5/32	1/16	0.049
5/16	18	5/8	7/32	3/32	0.065
3/8	16	3/4	17/64	3/32	0.065
7/16	14	13/16	17/64	3/32	0.083
1/2	12 or 13	7/8	17/64	1/8	0.083
9/16	12	1	5/16	1/8	0.083
5/8	11	1 1/8	23/64	5/32	0.109
3/4	10	1 3/8	29/64	5/32	0.134

For minimum and maximum lengths L, see Data Sheet No. 3, February, 1923.

MACHINERY'S Data Sheet No. 8, New Series, April 1923

MACHINERY'S Data Sheet No. 7, New Series, April 1923

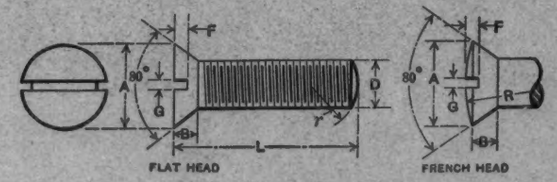
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PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

DIMENSIONS OF CAP-SCREWS AND COLLAR SCREWS

FLAT- AND FRENCH-HEAD CAP-SCREWS

(National Acme Co.)

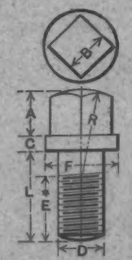


Outside Diameter of Screw, D	Number of Threads per Inch	Diameter of Head, A	Depth of Head, B	Depth of Slot, F	Width of Slot, G	Radius of French Head, R	Radius of point, r
1/8	40	1/4	5/64	0.037	0.025	3/8	1/8
3/16	24	3/8	7/64	0.056	0.037	9/16	3/16
1/4	20	15/32	1/8	0.075	0.050	45/64	1/4
5/16	18	5/8	3/16	0.094	0.062	15/16	5/16
3/8	16	3/4	7/32	0.112	0.075	1 1/8	3/8
7/16	14	13/16	7/32	0.131	0.087	1 7/32	7/16
1/2	12 or 13	7/8	7/32	0.150	0.100	1 5/16	1/2
9/16	12	1	17/64	0.169	0.112	1 1/2	9/16
5/8	11	1 1/8	19/64	0.187	0.125	1 11/16	5/8
3/4	10	1 3/8	3/8	0.225	0.150	2 1/16	3/4

For minimum and maximum lengths L, see Data Sheet No. 3, February, 1923

COLLAR SCREWS

(Hartford Machine Screw Co.)



Outside Diameter of Screw, D	Number of Threads per Inch	Length of Head, A	Size of Square, B	Thickness of Collar, C	Diameter of Collar, F	Radius of Head, R
1/8	40	1/8	1/8	1/16	1/4	1/4
3/16	24	3/16	3/16	5/64	11/32	5/8
1/4	20	1/4	1/4	5/64	7/16	1/2
5/16	18	5/16	5/16	7/64	1/2	5/8
3/8	16	3/8	3/8	1/8	5/8	3/4
7/16	14	7/16	7/16	1/8	11/16	7/8
1/2	12 or 13	1/2	1/2	3/16	13/16	1
9/16	12	9/16	9/16	7/32	15/16	1 1/8
5/8	11	5/8	5/8	15/64	1	1 1/4
3/4	10	3/4	3/4	9/32	1 1/4	1 1/2

*On all screws four inches long and under, threads are cut three-fourths of the length L; on screws longer than four inches, threads are cut half of the length L.

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MACHINERY'S DATA SHEETS Nos. 7 and 8

CUT OUT ON THIS LINE

CUT OUT ON THIS LINE

PUNCH O

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

PUNCH O

RANKINE'S AND EULER'S FORMULAS FOR COLUMNS

p = ultimate load in lbs. per square inch;
P = total ultimate load in lbs.;
S = ultimate compressive strength of material in pounds per square inch;
l = length of column or strut in inches;
r = least radius of gyration in inches;
r^2 = moment of inertia ÷ area of section;
I = least moment of inertia;
E = modulus of elasticity of material;
c = distance in inches from neutral axis of cross-section to side under compression;
z = distance in inches from axis of load to axis coinciding with center of gravity of cross-section.

Rankine's Formulas

Material	Both Ends of Column Fixed	One End Fixed and One End Rounded	Both Ends Rounded
Steel.....	$p = \frac{S}{1 + \frac{l^2}{25{,}000\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{12{,}500\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{6250\, r^2}}$
Cast iron.....	$p = \frac{S}{1 + \frac{l^2}{5000\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{2500\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{1250\, r^2}}$
Wrought iron...	$p = \frac{S}{1 + \frac{l^2}{35{,}000\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{17{,}500\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{8750\, r^2}}$
Timber.....	$p = \frac{S}{1 + \frac{l^2}{3000\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{1500\, r^2}}$	$p = \frac{S}{1 + \frac{l^2}{750\, r^2}}$

Formulas Modified for Eccentrically Loaded Columns

Material *	Both Ends of Column Fixed	One End Fixed and One End Rounded	Both Ends Rounded
Steel.....	$p = \frac{S}{1 + \frac{l^2}{25{,}000\, r^2} + \frac{cz}{r^2}}$	$p = \frac{S}{1 + \frac{l^2}{12{,}500\, r^2} + \frac{cz}{r^2}}$	$p = \frac{S}{1 + \frac{l^2}{6250\, r^2} + \frac{cz}{r^2}}$

*For other materials such as cast iron, etc., use the Rankine formulas given in the upper table and add to the denominator the quantity $cz \div r^2$

Euler's Formulas for Slender Columns

Both Ends of Column Fixed	One End Fixed and One End Rounded	Both Ends Rounded	One End Fixed and One End Free
$P = \frac{4\pi^2 IE}{l^2}$	$P = \frac{2\pi^2 IE}{l^2}$	$P = \frac{\pi^2 IE}{l^2}$	$P = \frac{\pi^2 IE}{4l^2}$

To find the total safe load for a given section, multiply the value of p (as found by any of the formulas given above), by the area of the section and divide by a suitable factor of safety.

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MACHINERY'S Data Sheet No. 10, New Series, May 1923

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MACHINERY'S Data Sheet No. 9, New Series, May 1923

PUNCH O

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

PUNCH O

RANKINE'S AND EULER'S FORMULAS FOR COLUMNS

STRENGTH OF COLUMNS OR STRUTS

The accompanying Data Sheet No. 10 gives formulas for calculating the ultimate load in pounds per square inch for columns. These formulas are based on the Rankine formula, which is the one generally used by engineers in the design of columns, unless the latter are unusually slender. When the length of a compressive member exceeds eight or ten times its smallest lateral dimension, it is ordinarily known as a column, strut, or post. Columns may, for the purpose of analysis, be divided into short columns and long columns. Short columns fail when the combined bending and compressive stresses reach the yield point of the material, but in long columns, failure occurs by buckling, before the load reaches the elastic limit.

The slenderness ratio of a column is found by dividing the length by the least radius of gyration (l/r), the length of column being in inches since the radius of gyration is commonly given in inches. The Rankine formula is generally applied for slenderness ratios between 20 and 100 and sometimes for ratios up to 120. In general, when the value of l/r exceeds 100, columns begin to fail by buckling, although the ratio varies according to the material and the support at the ends, as explained in the following: For ratios of l/r from 20 to about 100, there is little difference in the ultimate loads, especially for columns having fixed, flat and hinged ends; and the same formulas may be used when the ratios do not exceed the values given.

Euler's formulas (see Data Sheet No. 10) are commonly applied instead of Rankine's when the slenderness ratio of a column exceeds certain values which depend not only upon the material but also upon whether the ends are flat, hinged, rounded, or fixed. According to one series of experiments, Euler's formulas should be used when the values of l/r exceed the following ratios for columns of different materials: Structural steel with flat ends, 195; hinged ends, 155; round ends, 120. Cast iron with flat ends, 120; hinged ends, 100; round ends, 75. Oak with flat ends, 130. The difference in loading capacities for different values of l/r is shown by the table below. This table represents tests made at the Pencoyd Iron Works on wrought-iron columns.

ULTIMATE LOADS ON COLUMNS FOR DIFFERENT RATIOS OF SLENDERNESS

Ratio l/r	Fixed Ends	Flat Ends	Hinged Ends	Round Ends	Ratio l/r	Fixed Ends	Flat Ends	Hinged Ends	Round Ends
20	46,000	46,000	46,000	44,000	260	11,000	9800	6500	3800
60	36,000	36,000	36,000	30,500	300	9,000	7200	5000	2800
100	30,000	29,800	28,000	20,000	340	7,000	5100	4000	2100
140	25,500	23,500	21,000	12,800	380	5,800	3500	3000	1700
180	20,000	16,800	12,800	7,500	420	4,800	2500	2300	1300
220	15,000	12,700	8,800	5,000	440	4,300	2200	2100	....

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MACHINERY'S DATA SHEETS Nos. 9 and 10

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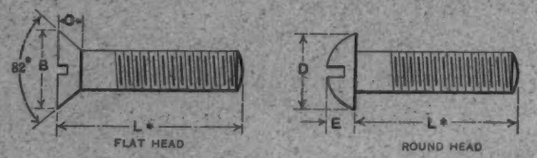
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PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

DIMENSIONS OF MACHINE SCREWS

FLAT-HEAD AND ROUND-HEAD MACHINE SCREWS*

(A. S. M. E. Standard and Special)



Screw Number	Outside Diameter, Inch	Size Flat Head to Nearest 1/64 Inch		Size Round Head to Nearest 1/64 Inch		Threads per Inch		
		B	C	D	E	A.S.M.E. Standard	A.S.M.E. Special	Other Pitches
0	0.060	7/64	1/32	7/64	3/64	80	.....	.....
1	0.073	9/64	1/32	1/8	3/64	72	64	.....
2	0.086	11/64	3/64	5/32	1/16	64	56	48
3	0.099	3/16	3/64	11/64	1/16	56	48	.....
4	0.112	7/32	1/16	13/64	5/64	48	36, 40	32
5	0.125	1/4	1/16	7/32	3/32	44	36, 40	32
6	0.138	17/64	5/64	1/4	3/32	40	32, 36	30
7	0.151	19/64	5/64	9/32	7/64	36	30, 32	.....
8	0.164	5/16	3/32	19/64	7/64	36	30, 32	.....
9	0.177	11/32	3/32	21/64	1/8	32	24, 30	.....
10	0.190	3/8	7/64	11/32	9/64	30	24, 32	.....
12	0.216	27/64	1/8	25/64	5/32	28	24	20
14	0.242	15/32	9/64	7/16	11/64	24	20	18
16	0.268	17/32	5/32	31/64	3/16	22	20	16, 18
18	0.294	37/64	11/64	35/64	13/64	20	18	16
20	0.320	5/8	11/64	19/32	7/32	20	18	16
22	0.346	11/16	3/16	41/64	15/64	18	16	.....
24	0.372	47/64	13/64	11/16	17/64	16	18	14
26	0.398	25/32	7/32	47/64	9/32	16	14	.....
28	0.424	27/32	15/64	25/32	19/64	14	16	.....
30	0.450	57/64	1/4	53/64	5/16	14	16	.....

*The minimum and maximum commercial lengths, and the amounts by which they increase from the shortest to the longest sizes listed, are given in Data Sheet No. 11, "Flat Fillister- and Oval Fillister-head Machine Screws."

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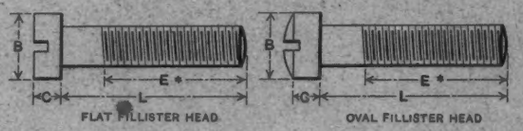
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PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH ○

DIMENSIONS OF MACHINE SCREWS

FLAT FILLISTER- AND OVAL FILLISTER-HEAD MACHINE SCREWS

(A. S. M. E. Standard and Special)



Screw Number	Outside Diam., Inch	Size of Head to Nearest 1/64 Inch		Threads per Inch			Shortest Lengths Listed*†	Longest Lengths Commonly Listed †
		B	C	A.S.M.E. Standard	A.S.M.E. Special	Other Pitches		
0	0.060	3/32	1/32	80	.....	.....	.....	.....
1	0.073	7/64	3/64	72	64	.....	.....	.....
2	0.086	1/8	3/64	64	56	48	1/8	7/8
3	0.099	5/32	1/16	56	48	.....	1/8	7/8, 15/16
4	0.112	11/64	5/64	48	36, 40	32	1/8	2
5	0.125	13/64	5/64	44	36, 40	32	1/8	2 1/4, 2 1/2
6	0.138	7/32	3/32	40	32, 36	30	1/8	2 1/4, 2 1/2
7	0.151	15/64	3/32	36	30, 32	.....	1/8	3
8	0.164	17/64	7/64	36	30, 32	.....	1/8	2 1/2, 3
9	0.177	9/32	7/64	32	24, 30	.....	3/16	3 1/2, 4
10	0.190	19/64	1/8	30	24, 32	.....	3/16	3 1/2, 4
12	0.216	11/32	9/64	28	24	20	1/4	3 1/2, 4
14	0.242	25/64	5/32	24	20	18	1/4	4
16	0.268	7/16	11/64	22	20	16, 18	5/16	4
18	0.294	15/32	3/16	20	18	16	3/8	4
20	0.320	33/64	13/64	20	18	16	3/8	4
22	0.346	9/16	7/32	18	16	.....	3/8	4
24	0.372	19/32	1/4	16	18	14	3/8	4
26	0.398	41/64	17/64	16	14	.....	3/4, 7/8	4
28	0.424	11/16	9/32	14	16	.....	3/4, 7/8	4
30	0.450	47/64	19/64	14	16	.....	3/4, 1	4

*The length *E* of the thread, according to the rule of the Scovill Mfg. Co., is as follows: Screws up to 1 inch long inclusive are threaded up to the head; longer screws are threaded three-fourths of the length. According to the rule of the Corbin Screw Corporation, machine screws having cut threads are threaded up to the head for lengths up to ½ inch inclusive; longer sizes are threaded two-thirds of the length.

†The amounts by which the lengths increase from minimum to maximum, according to the practice of several prominent screw manufacturers, are as follows: Lengths *L* up to 1 inch inclusive either by 1/16-inch increments, or by 1/16 inch up to 5/8 inch, and then by ⅛ inch up to 1 inch; lengths *L* from 1 to 2 inches, either by ⅛- or ¼-inch increments; lengths *L* from 2 to 4 inches, by ¼-inch increments.

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PUNCH

Punch-holes are spaced to fit standard loose-leaf

PUNCH

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Punch-holes are spaced to fit standard loose-leaf

PUNCH

PUNCH ○ ○ PUNCH

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

SPEEDS AND FEEDS FOR MILLING, DRILLING AND TURNING

Materials to be Machined. For materials marked (†) use a cooling compound. For those marked (‡) use lard oil or similar coolant.	Speeds in Feet per Minute at Largest Diameter—Figures given in Body of Table														
	Milling						Drilling		Turning						
	Carbon Steel Cutter		High-speed Steel Cutter		Stellite No. 3		Carbon Steel Drill	High-speed Steel	Carbon Steel Tool		High-speed Steel Tool		Stellite Tools		
	Rough.	Fin.	Rough.	Fin.	Rough.	Fin.			Rough.	Fin.	Rough.	Fin.	Stell. No.	Rough.	Fin.
Cast Iron															
Malleable	60	75	90	100	135	170	50	70	90	100	130	150	2	200	240
Mach. Castings	40	50	60	70	90	110	35	50	60	75	90	110	2	135	160
Medium Hard	20	25	30	40	45	55	16	25	30	35	45	50	3	70	85
Hard Castings	10	12	15	20	22	27	8	12	15	18	22	25	3	35	42
Steel Castings†	30	35	45	55	65	80	25	35	45	55	65	80	2	100	120
Machine Steel up to 0.30 Per Cent C.															
Soft†	60	75	90	110	135	170	50	70	90	110	130	160	1	200	240
Medium†	40	50	60	70	90	100	35	50	60	70	90	100	1	135	160
Fairly Hard†	25	35	40	50	55	80	20	30	35	45	50	65	1	80	95
Tool Steel, well annealed‡	25	35	40	50	55	80	20	30	35	45	50	65	2	80	95
Cr. Nickel Steel, annealed‡	25	35	40	50	55	80	20	30	35	45	50	65	2	80	95
Brass—Yellow	75	95	110	150	170	200	60	90	110	150	160	220	3	250	300
Bronze	40	50	60	70	90	100	35	50	60	70	90	100	2	135	160
Aluminum	460	550	700	900	1000	1200	350	550	700	900	1000	1300	3	1500	1800

FEEDS—The feed for rough-milling should be all that the machine, work, fixture, and tool will stand—the feed for roughing is usually too low. The feeds for finishing are, with spiral mills, about 0.005 inch per tooth per revolution; with face mills, about 0.010 inch per tooth per revolution. The drilling feeds per revolution are, for ⅛ inch diameter, 0.002 inch; ¼ inch diameter, 0.006 inch; ½ inch diameter, 0.007 inch; ¾ inch diameter, 0.010 inch. The feeds for rough-turning should be all that machine and work will stand. Finishing feed depends upon finish required, kind of material and tool.

These speeds and feeds were compiled by the Kempsmith Mfg. Co. as representing conservative modern practice. They are intended only as a general guide, and when all conditions are favorable, may often be increased considerably; or, in the case of hard materials, they must sometimes be less than those given. The speeds for tools of simple form which are easy to grind and replace, such as lathe tools, should be much higher than the speeds for tools, such as milling cutters, which are more difficult to grind and must last longer between the sharpening periods to secure greater economy. The speeds given in the table should be reduced for tools used in machines of the automatic class, because such tools, as a rule, require more time for resetting in the working position.

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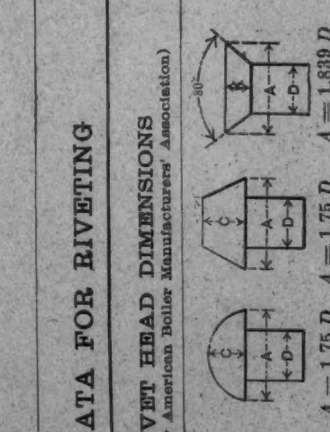
PUNCH ○ ○ PUNCH

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

DATA FOR RIVETING

RIVET HEAD DIMENSIONS

(Adopted by American Boiler Manufacturers' Association)



Diameter, Inches	Steeple		Button or Round		Cone			Countersunk	
D	A	C	A	C	A	B	C	A	K
1/2	1	1/2	7/8	3/8	7/8	15/32	7/16	15/16	1/4
9/16	1 1/8	9/16	63/64	27/64	63/64	17/32	31/64	1 1/32	9/32
5/8	1 1/4	5/8	1 3/32	15/32	1 3/32	19/32	35/64	1 5/32	5/16
11/16	1 3/8	11/16	1 13/64	33/64	1 13/64	41/64	39/64	1 17/64	11/32
3/4	1 1/2	3/4	1 5/16	9/16	1 5/16	45/64	21/32	1 3/8	3/8
13/16	1 5/8	13/16	1 27/64	39/64	1 27/64	49/64	23/32	1 1/2	13/32
7/8	1 3/4	7/8	1 17/32	21/32	1 17/32	13/16	49/64	1 19/32	7/16
15/16	1 7/8	15/16	1 41/64	45/64	1 41/64	7/8	13/16	1 23/32	15/32
1	2	1	1 3/4	3/4	1 3/4	15/16	7/8	1 27/32	1/2
1 1/16	2 1/8	1 1/16	1 55/64	51/64	1 55/64	1	15/16	1 61/64	17/32
1 1/8	2 1/4	1 1/8	1 31/32	57/64	1 31/32	1 1/16	63/64	2 1/16	9/16
1 3/16	2 3/8	1 3/16	2 5/64	57/64	2 5/64	1 7/64	1 1/32	2 3/16	19/32
1 1/4	2 1/2	1 1/4	2 3/16	15/16	2 3/16	1 11/64	1 3/32	2 19/64	5/8
1 3/8	2 3/4	1 3/8	2 13/32	1 1/32	2 13/32	1 9/32	1 13/64	2 17/32	11/16
1 1/2	3	1 1/2	2 5/8	1 1/8	2 5/8	1 13/32	1 5/16	2 3/4	3/4

PRESSURES FOR HOT RIVETING

Rivet Diameter, Inch	Class of Work and Pressure in Tons			Rivet Diameter, Inch	Class of Work and Pressure in Tons		
	Boiler	Tank	Girder		Boiler	Tank	Girder
1/2	20	15	9	1 1/8	75	60	38
5/8	25	18	12	1 1/4	100	70	45
3/4	33	22	15	1 1/2	125	85	60
7/8	45	30	22	1 3/4	150	100	75
1	60	45	30	.....	.....	.....	.....

The pressures required for hot riveting ordinarily range from 75,000 to 150,000 pounds per square inch of rivet area. The data in the table "Pressures for Hot Riveting" is from R. D. Wood & Co. It is assumed that the rivet passes through only two thicknesses of plate having a maximum total thickness not much in excess of the rivet diameter. Approximately four or five times as much power is required to drive rivets cold as to drive them hot.

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CUT OUT ON THIS LINE

PUNCH

PUNCH

PUNCH

CUT OUT ON THIS LINE

PUNCH O

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

PUNCH O

GEAR TOOTH PARTS

Diametral Pitch	Circular Pitch	Module (Metric System)	Circular Pitch	Thickness of Tooth at Pitch Line	Addendum	Whole Depth of Tooth
.....	.....	4	0.4944	0.2474	0.1575	0.3396
7	.....	.....	0.4488	0.2244	0.1429	0.3081
.....	7/16	.....	0.4375	0.2187	0.1393	0.3003
.....	.....	3 1/2	0.4328	0.2163	0.1378	0.2972
8	.....	.....	0.3927	0.1963	0.1250	0.2696
.....	3/8	.....	0.3750	0.1875	0.1194	0.2575
.....	.....	3	0.3708	0.1854	0.1181	0.2547
9	.....	.....	0.3491	0.1745	0.1111	0.2397
.....	.....	2 3/4	0.3401	0.1700	0.1082	0.2335
10	.....	.....	0.3142	0.1571	0.1000	0.2157
.....	5/16	.....	0.3125	0.1562	0.0995	0.2146
.....	.....	2 1/2	0.3090	0.1545	0.0984	0.2123
11	.....	.....	0.2856	0.1428	0.0909	0.1961
.....	.....	2 1/4	0.2781	0.1390	0.0885	0.1910
12	.....	.....	0.2618	0.1309	0.0833	0.1798
.....	1/4	.....	0.2500	0.1250	0.0796	0.1716
.....	.....	2	0.2472	0.1236	0.0787	0.1698
13	.....	.....	0.2417	0.1208	0.0769	0.1659
14	.....	.....	0.2244	0.1122	0.0714	0.1541
.....	.....	1 3/4	0.2163	0.1081	0.0688	0.1486
15	.....	.....	0.2094	0.1047	0.0666	0.1438
16	.....	.....	0.1963	0.0982	0.0625	0.1348
.....	3/16	.....	0.1875	0.0937	0.0597	0.1287
.....	.....	1 1/2	0.1854	0.0927	0.0590	0.1273
17	.....	.....	0.1848	0.0924	0.0588	0.1269
18	.....	.....	0.1745	0.0873	0.0555	0.1198
19	.....	.....	0.1653	0.0827	0.0526	0.1135
20	.....	.....	0.1571	0.0785	0.0500	0.1079
.....	.....	1 1/4	0.1545	0.0772	0.0492	0.1061
.....	5/32	.....	0.1562	0.0781	0.0497	0.1073
22	.....	.....	0.1428	0.0714	0.0455	0.0980
24	.....	.....	0.1309	0.0654	0.0417	0.0898
.....	1/8	.....	0.1250	0.0625	0.0398	0.0858
.....	.....	1	0.1236	0.0618	0.0393	0.0849
26	.....	.....	0.1208	0.0604	0.0385	0.0829
28	.....	.....	0.1122	0.0561	0.0357	0.0770
30	.....	.....	0.1047	0.0524	0.0333	0.0719
32	.....	.....	0.0982	0.0491	0.0312	0.0674
.....	3/32	.....	0.0937	0.0469	0.0298	0.0644
.....	.....	3/4	0.0927	0.0463	0.0295	0.0636
34	.....	.....	0.0924	0.0462	0.0294	0.0634
36	.....	.....	0.0873	0.0436	0.0278	0.0599
40	.....	.....	0.0785	0.0393	0.0250	0.0539
.....	1/16	.....	0.0625	0.0312	0.0199	0.0429
.....	.....	1/2	0.0618	0.0309	0.0198	0.0424

MACHINERY'S Data Sheet No. 16, New Series, August 1923 — Contributed by E. G. Bishop

CUT HERE

MACHINERY'S Data Sheet No. 15, New Series, August 1923 — Contributed by E. G. Bishop

PUNCH O

Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

PUNCH O

GEAR TOOTH PARTS

Diametral Pitch	Circular Pitch	Module (Metric System)	Circular Pitch	Thickness of Tooth at Pitch Line	Addendum	Whole Depth of Tooth
1	.....	.....	3.1416	1.5708	1.0000	2.1571
.....	3	.....	3.0000	1.5000	0.9549	2.0598
.....	.....	24	2.9669	1.4834	0.9449	2.0380
1 1/4	.....	.....	2.5133	1.2566	0.8000	1.7257
.....	2 1/2	.....	2.5000	1.2500	0.7957	1.7165
.....	.....	20	2.4724	1.2362	0.7874	1.6984
.....	.....	18	2.2252	1.1126	0.7087	1.5284
1 1/2	.....	.....	2.0944	1.0472	0.6666	1.4381
.....	2	.....	2.0000	1.0000	0.6366	1.3732
.....	.....	16	1.9786	0.9893	0.6299	1.3584
1 3/4	.....	.....	1.7952	0.8976	0.5714	1.2326
.....	1 3/4	.....	1.7500	0.8750	0.5570	1.2016
.....	.....	14	1.7314	0.8657	0.5512	1.1888
2	.....	.....	1.5708	0.7854	0.5000	1.0785
.....	1 1/2	.....	1.5000	0.7500	0.4775	1.0299
.....	.....	12	1.4835	0.7416	0.4724	1.0190
2 1/4	.....	.....	1.3963	0.6981	0.4444	0.9587
.....	.....	11	1.3606	0.6803	0.4331	0.9342
2 1/2	.....	.....	1.2566	0.6283	0.4000	0.8628
.....	1 1/4	.....	1.2500	0.6250	0.3979	0.8583
.....	.....	10	1.2362	0.6181	0.3937	0.8492
2 3/4	.....	.....	1.1424	0.5712	0.3636	0.7844
.....	.....	9	1.1126	0.5563	0.3543	0.7642
3	.....	.....	1.0472	0.5236	0.3333	0.7190
.....	1	.....	1.0000	0.5000	0.3183	0.6866
.....	.....	8	0.9894	0.4947	0.3150	0.6792
.....	15/16	.....	0.9375	0.4687	0.2984	0.6437
3 1/2	.....	.....	0.8976	0.4488	0.2857	0.6163
.....	7/8	.....	0.8750	0.4375	0.2785	0.6007
.....	.....	7	0.8657	0.4328	0.2756	0.5944
.....	13/16	.....	0.8125	0.4062	0.2586	0.5579
4	.....	.....	0.7854	0.3927	0.2500	0.5393
.....	3/4	.....	0.7500	0.3750	0.2387	0.5150
.....	.....	6	0.7416	0.3708	0.2362	0.5095
4 1/2	.....	.....	0.6981	0.3490	0.2222	0.4793
.....	11/16	.....	0.6875	0.3437	0.2189	0.4720
.....	.....	5 1/2	0.6803	0.3401	0.2165	0.4671
5	.....	.....	0.6283	0.3142	0.2000	0.4314
.....	5/8	.....	0.6250	0.3125	0.1989	0.4291
.....	.....	5	0.6181	0.3090	0.1969	0.4246
5 1/2	.....	.....	0.5712	0.2856	0.1818	0.3922
.....	9/16	.....	0.5625	0.2812	0.1790	0.3862
.....	.....	4 1/2	0.5562	0.2781	0.1771	0.3821
6	.....	.....	0.5236	0.2618	0.1666	0.3595
.....	1/2	.....	0.5000	0.2500	0.1592	0.3433

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MACHINERY'S DATA SHEETS Nos. 15 and 16

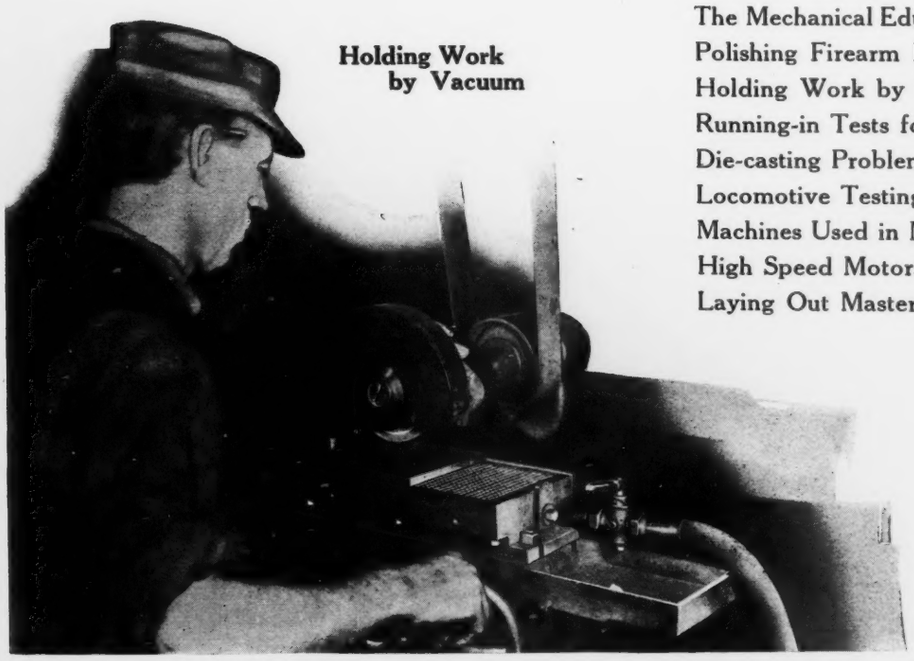
September MACHINERY

Here are two writers, two totally dissimilar articles and a single moral. There are great opportunities —greater today than ever—for inventive genius in the machinery field; and there is an insistent demand for men with thorough mechanical knowledge to design and develop the tools and machines that are needed.

It is the fashion of the moment to ask "Why should I read, why should I spend hours in study when day laborers are demanding and getting more wages than I?" The two articles from which we have quoted go a long way toward showing why this is a false viewpoint—a viewpoint resulting from a temporary condition in the labor market which cannot last any length of time. A laborer, as such, will be always a laborer. With education men create, contribute great things to the advancement of civilization, and are recompensed in direct proportion to the value of their creations.

Read the Gabrielson and Nevin articles in September MACHINERY—there is real inspiration in them for the man who means to win out. They are plain, matter-of-fact stories which make their meaning clear in the direct manner common to mechanical men who write for publication when they have something to say which they feel is worth saying, but they carry a message.

A partial list of the articles MACHINERY will publish in September follows —and not one but might well be a stone in the structure of education.



Holding Work by Vacuum

Special Machines in a Typewriter Plant
The Mechanical Education of a Draftsman
Polishing Firearm Parts
Holding Work by Vacuum
Running-in Tests for Machine Tool Units
Die-casting Problems
Locomotive Testing Laboratory
Machines Used in Making Electric Lamps
High Speed Motors for Machine Tools
Laying Out Master Cam Templets

Educational Number

LELAND-GIFFORD COMPANY · WORCESTER MASS. U.S.A. · MACHINE TOOLS - CRANK SHAFTS

Leland-Gifford Service

You Have Drilling and Tapping Problems?

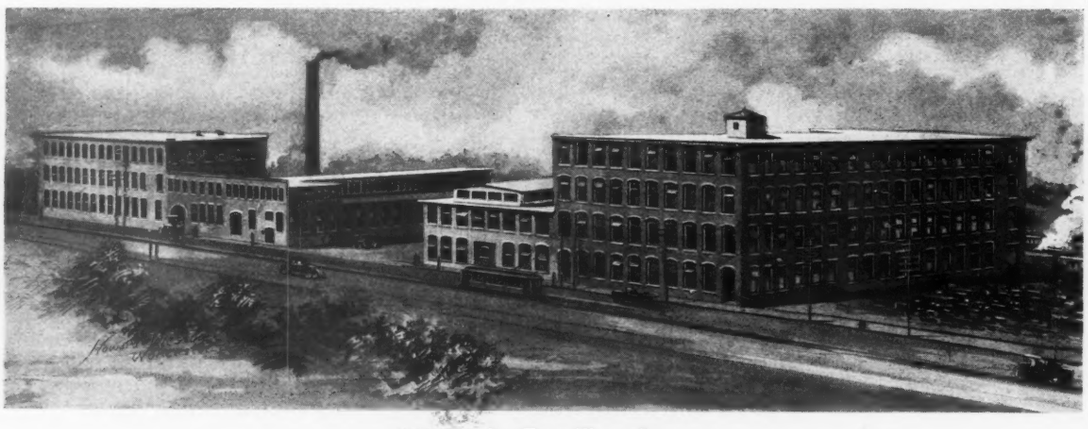
Leland-Gifford Service Department wants to take up with you those drilling and tapping problems that have been troubling you and apply to their solution the knowledge and experience gained through years of specializing on this subject.

Branch offices are maintained in the following cities with experts in the solution of drilling problems in charge:

BOSTON CHICAGO DETROIT
NEW YORK ROCHESTER

THE PLANT BEHIND THIS SERVICE

The Service is backed up by the LELAND-GIFFORD FACTORY which represents twenty-three years' steady growth.



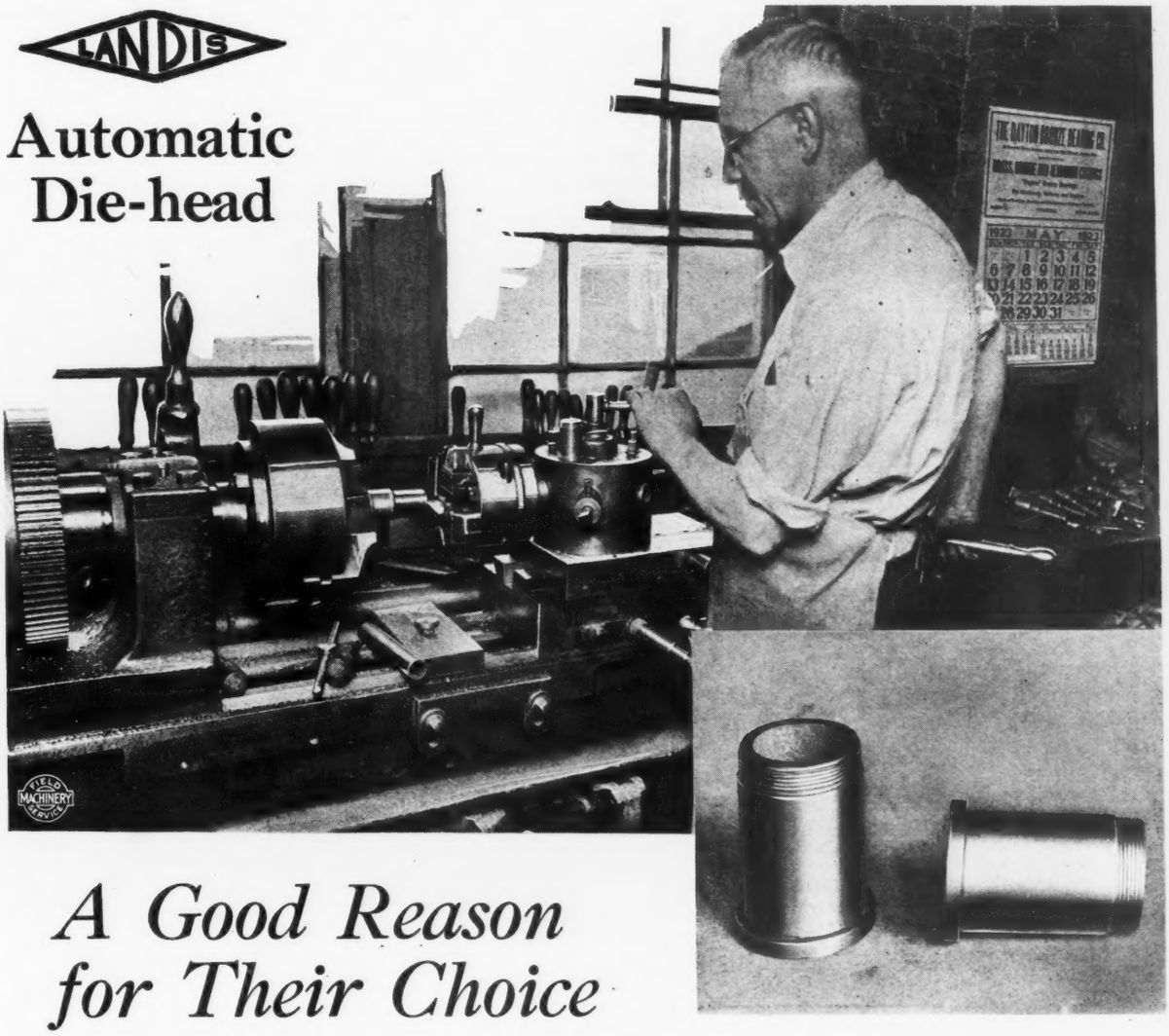
121,000 Sq. Feet Floor Space

LELAND-GIFFORD COMPANY

WORCESTER, MASS., U.S.A.

LANDIS

Automatic Die-head



A Good Reason for Their Choice

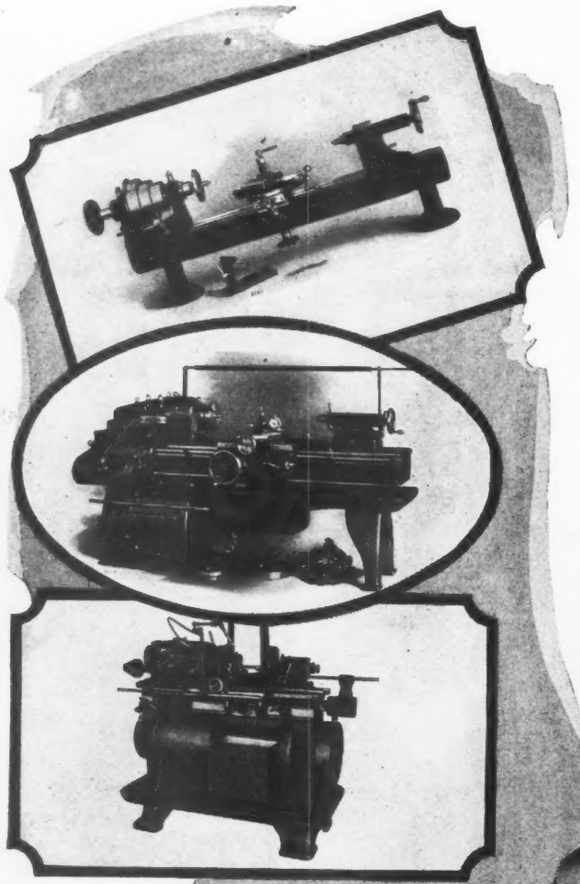
We're going to let the superintendent of the Philip Haas Company write this advertisement for us—going to quote what he said when we asked why he bought one of the new Landis Automatic Die-heads.

"We have a Landis Bolt Threader down stairs," said he, "the first one in Dayton and it threaded our 1″ pipe so fast that people came here from outside to see it work. That machine sold other Landis Bolt Threaders in Dayton and it was due to our pleasant experience with it that we bought this Landis Automatic Die. The chasers are of the same design. When we got this die, a year ago, we put it on the hardest job in the shop, cutting 27 threads per inch for a distance of 5/16″ on brass tubing 1¼″ diameter. Our trouble on this job had been that we never were able to get a perfect thread with other dies, the first two threads would usually be stripped. The Landis, however, cut a perfect thread right from the start."

You too, can cut perfect threads with our New Automatic Die-head. Let us tell you about it.

LANDIS MACHINE CO., Inc., Waynesboro, Pa., U.S.A.

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Company of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Company, St. Louis, Mo.; R. B. Whitacre & Co., St. Paul, Minn. Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward Wight & Co, New Orleans, La.; Joseph T. Ryerson & Son, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Eccles & Smith Company, San Francisco, Calif.; Los Angeles, Calif.; Portland, Ore.; Hallidie Mchy. Co., Seattle, Wash. Hallidie Company, Spokane, Wash; CANADIAN AGENTS: Canadian Fairbanks-Morse Company, Toronto and Montreal. FOREIGN AGENTS: Burton Griffiths Co., London, England; Allied Machinery Company, Barcelona, Spain; Turin, Italy; Zurich, Switzerland; Tientsin, China; R. S. Stokvis & Zonen, Rotterdam, Holland; Dutch East Indies D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney, Australia; Alfred Herbert, Ltd., Calcutta, India and Yokohama, Japan.



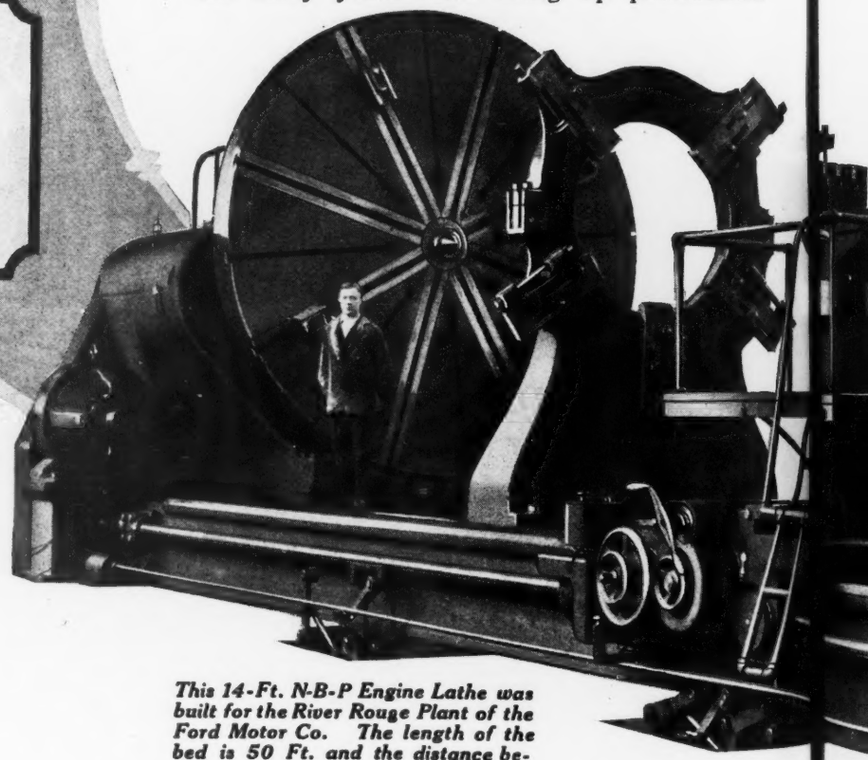
FOR LATHES of E

"Come to He

IN four of our six great plants are produced the lathes that have carried the Niles-Bement-Pond name to every corner of the industrial world.

From our Pratt & Whitney Works at Hartford, Conn., come the Bench and Toolmakers' Lathes, the high-production Automatic Lathes that so well sustain the Pratt & Whitney reputation for precision machine building.

In our Niles Tool Works, Hamilton, Ohio, are built the Carwheel and Driving Wheel Lathes, the Axle and Journal Lathes that for forty years have hung up production



This 14-Ft. N-B-P Engine Lathe was built for the River Rouge Plant of the Ford Motor Co. The length of the bed is 50 Ft. and the distance between centers is 34 Ft. Total weight is about 250,000 lbs.

PRATT & WHITNEY BENCH LATHE

This 7" x 32" Bench Lathe is the smallest lathe we build. Its extreme accuracy, convenience of operation and adaptability to all kinds of small work, make it indispensable to the toolmaker. Pratt & Whitney quality throughout. Circular No. 289.

PRATT & WHITNEY 16-LATHE

A precision lathe of entirely new design. The most radical departure from usual practice is the new, compact headstock centered over the bed with all back gears mounted below the spindle. This eliminates overhanging parts and gives the operator uninterrupted light on the work. Maag gearing is used throughout. This machine represents the latest development of high production precision lathe building. Circular No. 300.

P & W FULL AUTOMATIC LATHE

Does entirely automatically all lathe operations ordinarily performed by hand operated engine lathe. Provided with magazine it also loads machine and discharges the finished work entirely automatically. Circular No. 284.

WORKS

Niles Tool Works, Hamilton, O.

Bement Works, Philadelphia, Pa.

Pond Works, Plainfield, N. J.

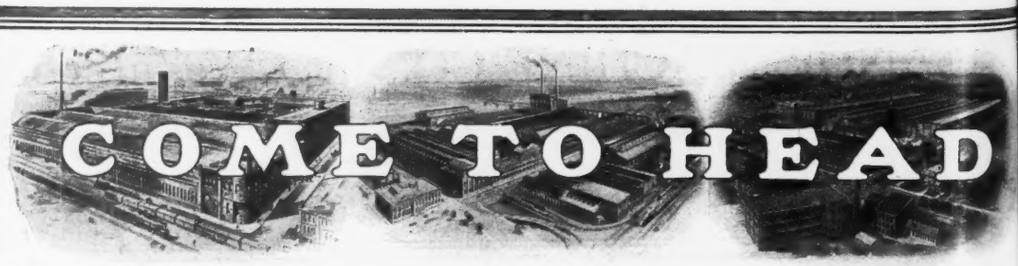
Pratt & Whitney Wks, Hartford, Conn.

Ridgway Works, Ridgway, Pa.

Niles Crane Works, Philadelphia, Pa.

NILES-BEMENT-P

General Offices:



EVERY TYPE

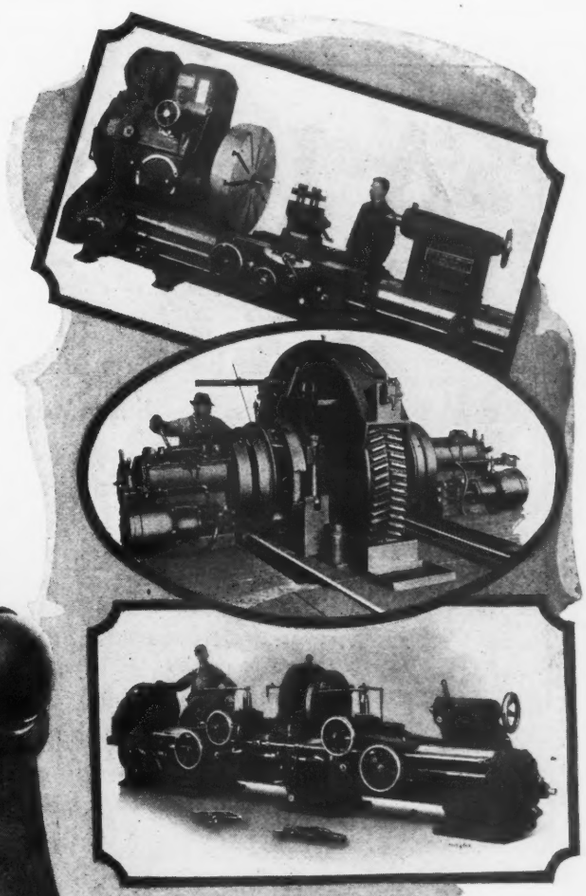
Headquarters"

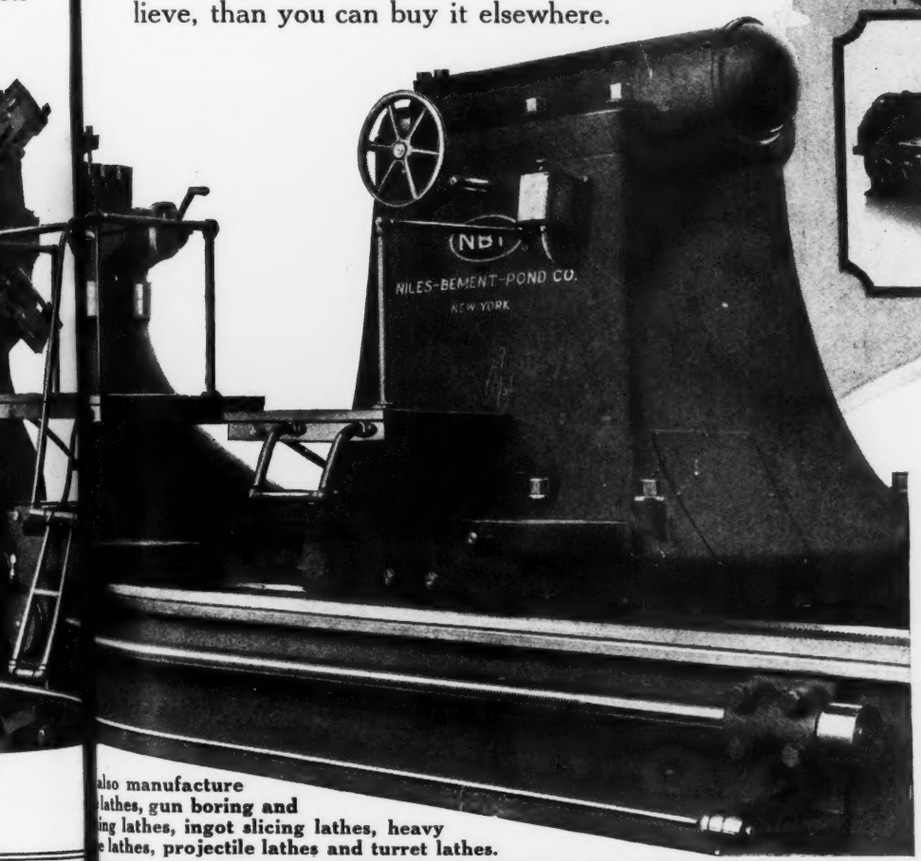
records in railroad shops throughout this country and abroad.

In Plainfield, N. J., the Pond Works produce the heavy Engine Lathes that are standard equipment in nearly every shop where metal is turned, while the monster gun-boring and turning lathes that make our arsenals the best equipped in the world are built by our Bement Works in Philadelphia.

A generation of specialized experience is put into this equipment.

There's nothing in metal turning machinery that we cannot build for you—better, we believe, than you can buy it elsewhere.





also manufacture
lathes, gun boring and
ing lathes, ingot slicing lathes, heavy
e lathes, projectile lathes and turret lathes.

N-B-P ENGINE LATHES

Made in standard sizes, 26, 30 and 36", in heavy types from 36" to 96" size; lathes larger than 96" swing are made to order and have been made up to 168" diameter.

N-B-P CAR WHEEL LATHES

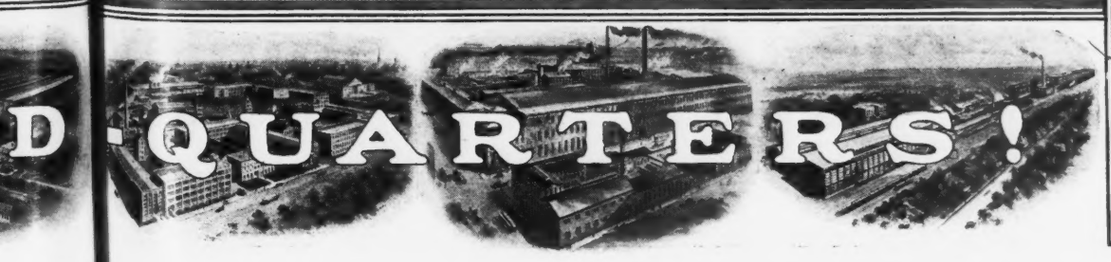
Built in end driven and center-driven types. Both types are high production equipment. The center-driven machine illustrated above is driven by herringbone gear, hinged segment operates automatically to admit wheel axles. Is equipped with patented equalizing drivers, pneumatically operated tailstocks and pneumatic tool clamps.

N-B-P DRIVING WHEEL LATHES

Built in sizes from 60 to 90 inches. Every improvement that will speed up operation and save labor has been incorporated. They include pneumatic tool clamps, patented equalizing drivers, rapid power traverse to headstock, pneumatic headstock clamp, push button sped control.

T-POND COMPANY

111 Broadway, New York City



SALES OFFICES

New York
Boston
Philadelphia
Birmingham
Rochester
Pittsburgh
Cleveland
Detroit
Chicago
Cincinnati
St. Louis
St. Paul
San Francisco
Los Angeles

A Lodge & Shipley

Why?

Merely because it is accurate? No!

Because it will retain its accuracy over a long period of time? No!

Because of its simplified construction and ease of operation? No!

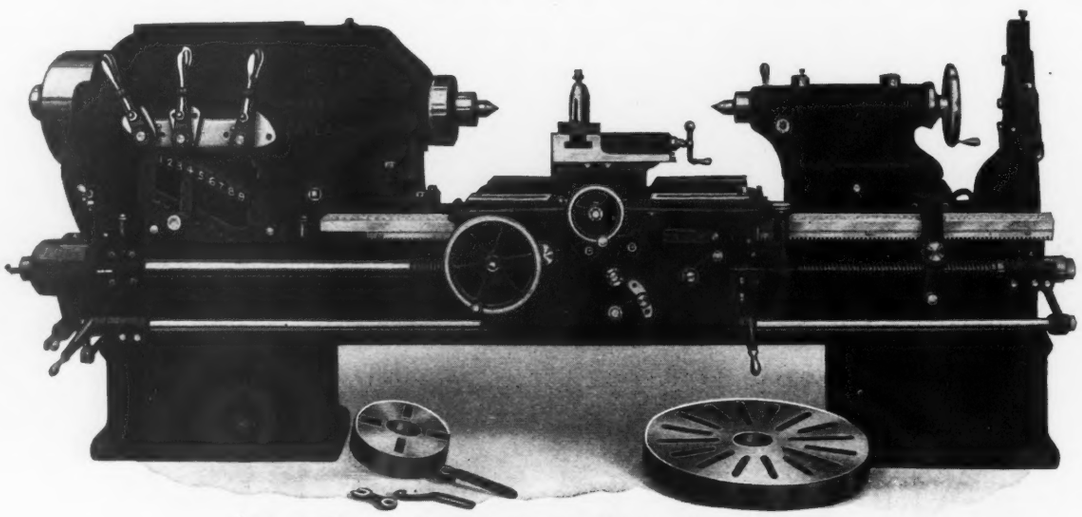
Well then, why is it?

It is because it has that rare combination of all these essentials. It is accurate and adaptable. Accuracy is retained throughout a long period of usefulness. It is easy to operate. Its construction is simple.

That is why YOU will never regret its purchase.
That is why it can do more and better work.
That is why it is a **better lathe!**

In short, it is a lathe you always will be proud to own.
—and that's that!

The Lodge & Shipley Selective Head Lathe



24" Selective Head Lodge & Shipley Engine Lathe
Made in sizes 14" to 48"

The Lodge & Shipley

CINCINNATI,

is better!

A few reasons why:

Ball Bearings on every transmission shaft of the Selective Headstock practically eliminate friction. This means less wear with consequent longer life.

Lubrication. In the Lodge & Shipley Selective Headstock all gears and bearings are always in a bath of oil or are thoroughly lubricated through a continuous splash system. All oil supplied the spindle bearings is thoroughly filtered.

Double Nosed Spindle. The inner nose, which is left blank, extends beyond the outer nose and accurately centers the faceplate or chuck plate so that it easily engages the internal threads of the outer nose.

Mechanical Apron Control eliminates lost time in starting and stopping the lathe. A handle at the right of the apron affords the operator control of the lathe without having to move from in front of the work.

Double Walled Apron. This construction allows solid support, both front and rear, to all shafts. All gears in the apron are of steel. All are of sufficient strength to withstand any feed change while a cut is under way.

Chilled Bed. The chilled ways of the Lodge & Shipley Lathe bed are so much harder than the carriage that they prolong the life of the lathe. What little wear does occur on the carriage can be compensated for by gibs that may be adjusted to remove all play.

Micrometer Ball Stop. This ingenious device on the cross feed screw greatly simplifies threading operations by providing an adjustable depth stop. When the friction is entirely released the Ball Stop in no way affects the ordinary operation of the screw.

There are other reasons

Send today for our general catalogue.

It tells the whole story. No obligation.

Machine Tool Co.

OHIO

BAUSH METAL
DURALUMIN

A Few Advantages
MACHINING

Better than aluminum.
Cost greatly reduced when compared with iron or steel.
Taps and threads well.

RECIPROCATING PARTS

Weight reduced without loss of strength.
Acceleration increased.
Inertia decreased.

Polishes easily.
Resists atmospheric conditions.
No plating required.

Can be rolled, forged, drawn, heat-treated and annealed.
Hot and cold worked.

A QUALITY METAL

Duralumin is an alloy produced after years of systematic endeavor to meet the demand for a metal which shall be as light as Aluminum and as strong as mild steel, yet without the many disadvantages of Aluminum in its pure state.

Duralumin is the only light metal that can replace steel in forgings. With a two-thirds saving in weight, heat-treated Duralumin Forgings approximate mild steel forgings in strength.

Wherever weight is a deciding factor Duralumin is the most satisfactory metal for most articles made by hot working or forging. Naturally, Duralumin Forgings are especially desirable for reciprocating or moving parts where inertia, due to their own weight, forms a large part of the total stress.

Minimum Physical Properties of Rolled or Sheet Metal (heat-treated) and of Forging Metal are:

Tensile .....55,000 lbs. per sq. inch
Elastic Limit.....30,000 lbs. per sq. inch
Elongation.....18% in 2 inches

BAUSH MACHINE TOOL COMPANY

Metals Division

SPRINGFIELD, MASS., U. S. A.

Manufacturers of

BAUSH METAL

A Superior DURALUMIN

Blooms—Slabs—Billets—Sheets—Forgings

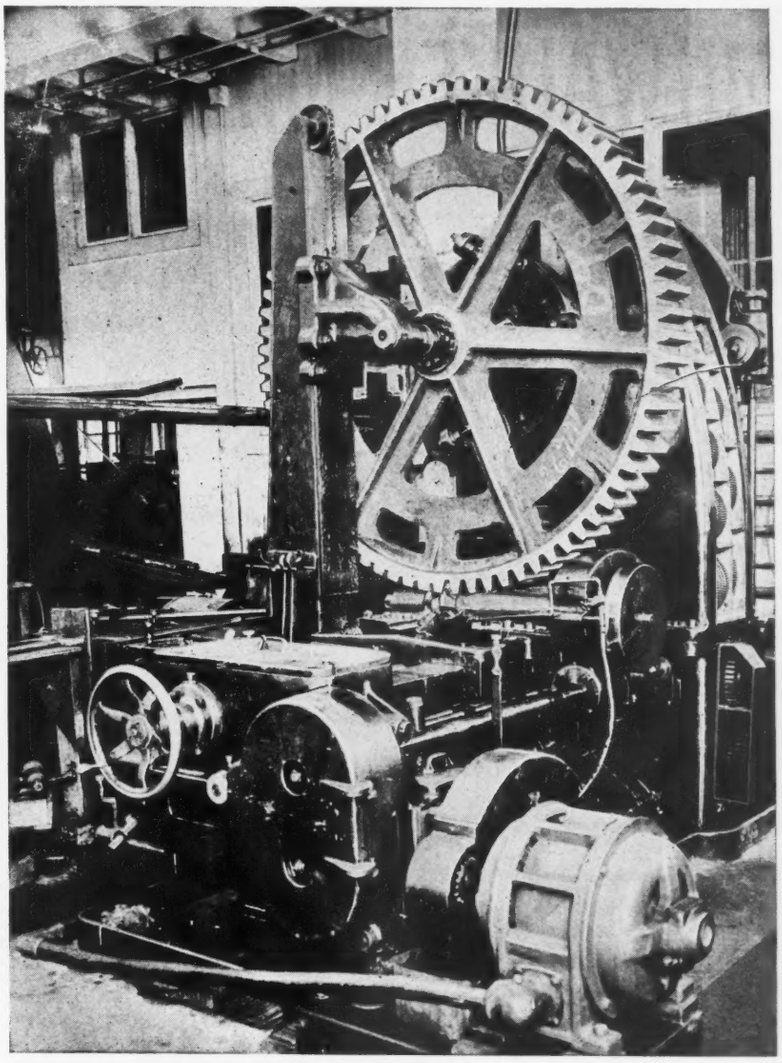
BAUSH CASTING METAL INGOTS

Aluminum Alloy of High Tensile Strength

Rolling Mill and Drop Forge Works
SPRINGFIELD, MASS.

DETROIT OFFICE:
1834 Dime Savings Bank Bldg.

Coarse Pitch Gears Finished for Quiet Running



In operation the sound of this finished gear and its mating pinion could not be detected at a distance of twenty feet.

These results are being obtained by The Smith & Watson Iron Works, Portland, Oregon; using an 84″ x 24″ Cincinnati Spur Gear Cutter.

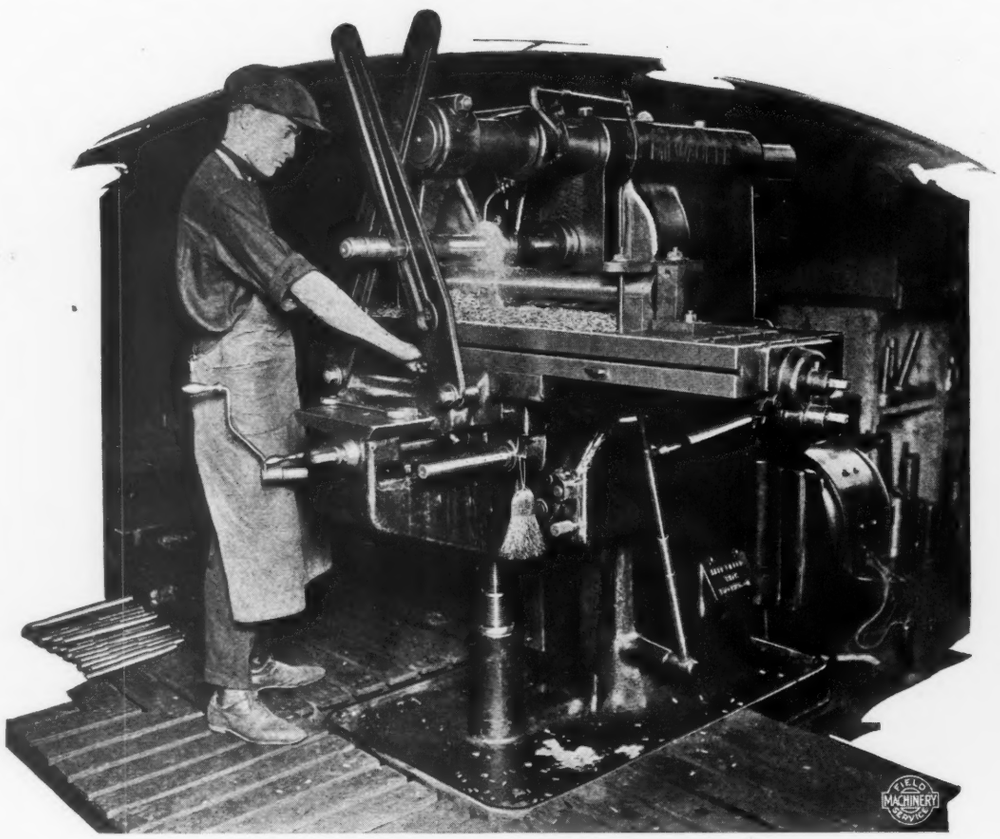
The operation pictured is cutting 76 teeth 3″ circular pitch for a cast steel gear 74″ diameter and 7″ face. Roughing and finishing feeds were 1¼ inches per minute. Cutter diameter is 8½ inches and speed 20 R.P.M.

The Cincinnati Gear Cutting Machine Co.

(Subsidiary of the Cincinnati Shaper Company)

CINCINNATI, OHIO, U. S. A.

MILWAUKEE MILLING MACHINES



Some Feed!

Cutting keyways 7/8" wide by 7/16" deep by 22 1/4" long in .40 carbon steel transmission shafts in one cut at a feed of 10" per minute, is going some.

That's what the Milwaukee Milling Machine was doing at the Austin Manufacturing Co., Harvey, Ill., when this photograph was taken. It is this sort of performance which makes them (as well as so many other users) pronounce Milwaukee Millers "great machines." Design gives wide range and great operating convenience, construction enables them to stand up to their work.



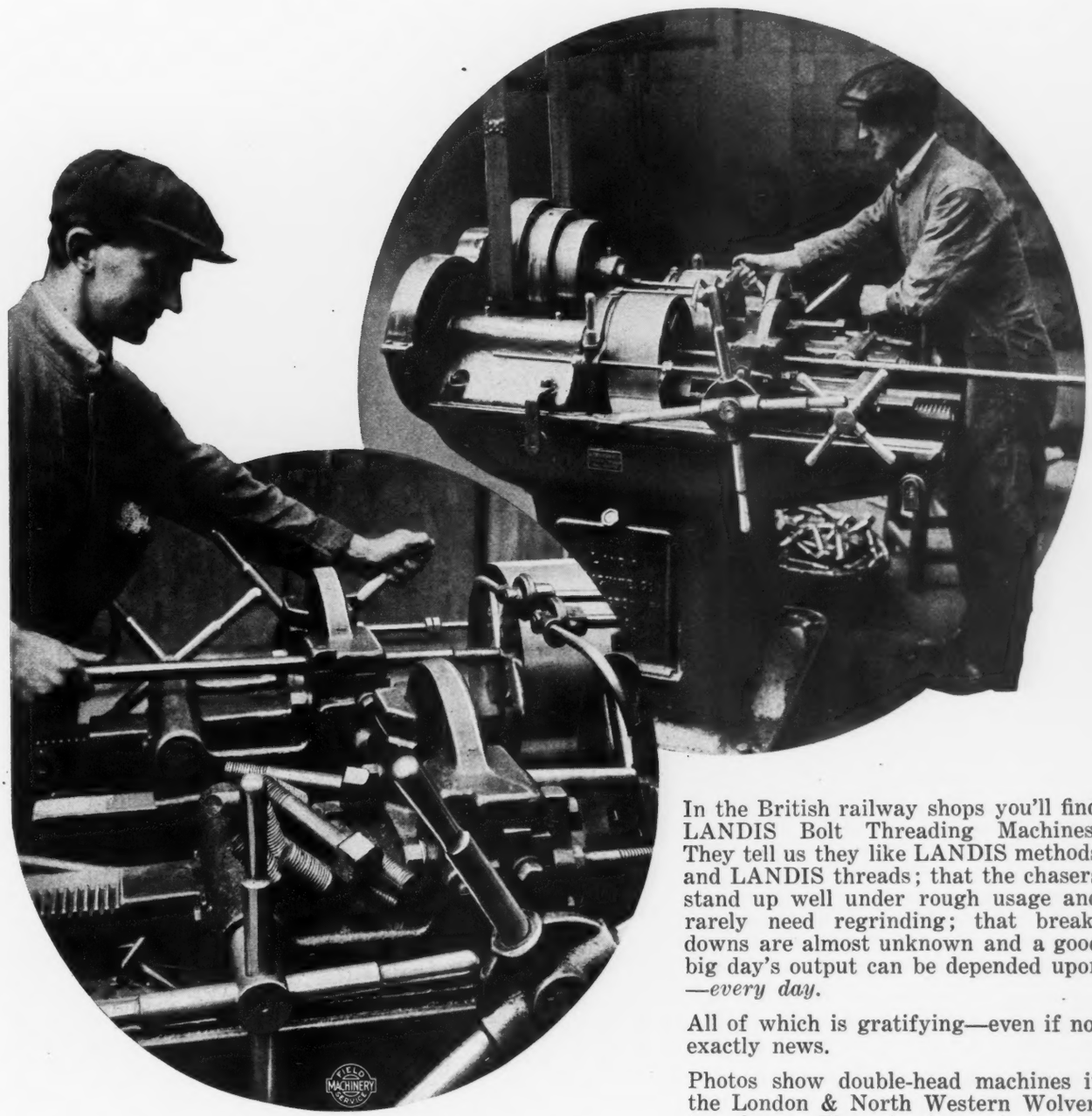
Send for specifications of Milwaukee Milling Machines and details of other records.



KEARNEY & TRECKER
CORPORATION
MILWAUKEE, WIS., U.S.A.

CHICAGO OFFICE 631 WASHINGTON BLVD
CLEVELAND OFFICE 738 SUPERIOR AVE. N.W.
NEW YORK OFFICE 50 CHURCH STREET

Around the World with LANDIS



In the British railway shops you'll find LANDIS Bolt Threading Machines. They tell us they like LANDIS methods and LANDIS threads; that the chasers stand up well under rough usage and rarely need regrinding; that breakdowns are almost unknown and a good big day's output can be depended upon —*every day.*

All of which is gratifying—even if not exactly news.

Photos show double-head machines in the London & North Western Wolverton shops. There is also a single head LANDIS in this shop. Wrought iron bolts are being threaded; 5/8" x 2¾" 11 threads per inch, Whitworth pitch, in 9 seconds each (actual threading time); and 1" x 2½" 8 threads, Whitworth, in 8 seconds each. Output per day (8½ hours) averages about 2000 in each instance.

You'll find LANDIS machines everywhere—always making good.

LANDIS MACHINE COMPANY

INCORPORATED

WAYNESBORO PA., U. S. A.

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Company of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Company, St. Louis, Mo.; R. B. Whitacre & Co., St. Paul, Minn.; Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward, Wight & Co., New Orleans, La.; Joseph T. Ryerson & Son, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Eccles & Smith Company, San Francisco, Calif.; Los Angeles, Calif.; Portland, Ore.; Hallidie Mchy. Co., Seattle, Wash.; Hallidie Company, Spokane, Wash.; CANADIAN AGENTS: Canadian Fairbanks-Morse Company, Toronto and Montreal. FOREIGN AGENTS: Burton Griffiths Co., London, England; Allied Machinery Company, Barcelona, Spain; Turin, Italy; Zurich, Switzerland; Tientsin, China; R. S. Stokvis & Zonen, Rotterdam, Holland; Dutch East Indies; D. Drury & Co., Johannesburg, South Africa; Benson Brothers, Sydney, Australia; Alfred Herbert, Ltd., Calcutta, India and Yokohama, Japan.

LANDIS

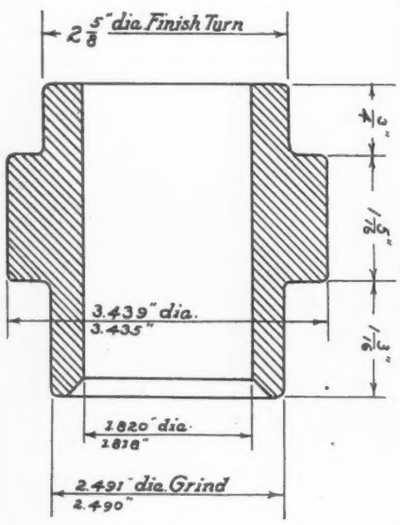


This "Libby" works twenty-two hours every day.

IF IT'S PRODUCTION—

"Leave It to Libby"

In this big shop quantity production was wanted on automobile axles, propeller shafts and their component parts, tough material—deep cuts—no let-up. A good specimen of the work is this differential gear blank. Bar stock of 3½" diameter is drilled, simultaneously two hubs are formed and outside diameter turned, two of these sizes are finished and outer hub roughed; latter is box-tooled to finish and hole bored to size with a .001" limit.



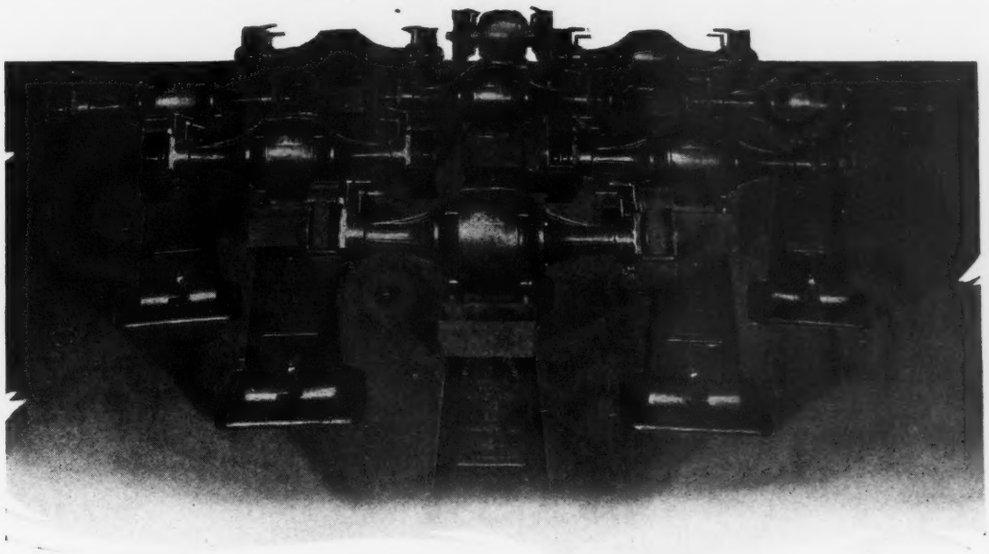
And the time—20 minutes! Pretty good? Write for a Libby estimate on your work. Cost—nothing but the effort.

International Machine Tool Co.

Indianapolis, Ind.

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore, Md.; Blackman-Hill-McGee Machinery Co., St. Louis, Mo.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore., Seattle, Wash.; E. L. Essley Machinery Co., Chicago, Ill., Milwaukee, Wis.; Hill, Clarke & Co., Boston, Mass. Seifreat-Woodruff Co., Cincinnati, Ohio, Dayton, Ohio; Strong, Carlisle & Hammond Co., Detroit, Mich., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York, N. Y., New Haven, Conn., Philadelphia, Pa.; Peden Iron & Steel Co., Houston, Texas. FOREIGN AGENTS: Coats Machine Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque Todd & Co., Belgium; Iznosskoff & Co., Petrograd, Russia, Moscow, Ekaterinburg, Russia; V. Lowener, Copenhagen, Denmark, Christiania, Norway, Stockholm, Sweden; Victor R. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France; Mitsui & Co., Japan.

SKF



Longer Life and Fewer Dressings
When Grinders are Ball Bearing Equipped

WITH **SKF** marked self-aligning ball bearings on the spindles of its grinders a large industrial plant found that it was necessary to dress the wheels only three times a day instead of every forty minutes as was necessary when babbitt bearings were used and that the life of the wheels was prolonged 40 per cent.

This better performance with self-aligning ball bearings is due to the fact that the chrome steel balls roll practically frictionless and without discernible wear over the hardened steel races and that dust and grit which play havoc with sleeve types of bearings are effectively excluded from the bearing housings by means of felt seals. Furthermore lubricant cannot escape and need be applied only at infrequent intervals.

May our engineers co-operate in bringing these advantages of ball bearings and their power-saving features to your grinders and other machine tools.

THE SKAYEF BALL BEARING COMPANY
Supervised by **SKF** INDUSTRIES, INC., 165 Broadway, New York City

974



Normal View *Deflected View*

BALL BEARINGS
The Highest Expression of the Bearing Principle

LATHES **AMERICAN** PLANERS



"None Better"—The Verdict Never Varies

Travel from shop to shop, the length and breadth of the land, you will find "American" Lathe users wherever you go—in Uncle Sam's big arsenals, in shipyards, automobile factories, contract shops and big repair shops; and practically every machine tool builder (the most critical class of machine users) counts his "American" units among his most important and profitable equipment. The heavy duty "American" Lathe shown was photographed while being used to put the finishing touches to the second of a pair of bodies—19″ long overall and 17″ at the plug end—which had been turned for their full length, ready for finish grinding. This, of course, means the maintenance of close limits and a surface correspondingly smooth.

THE AMERICAN TOOL WORKS COMPANY

CINCINNATI, U. S. A.

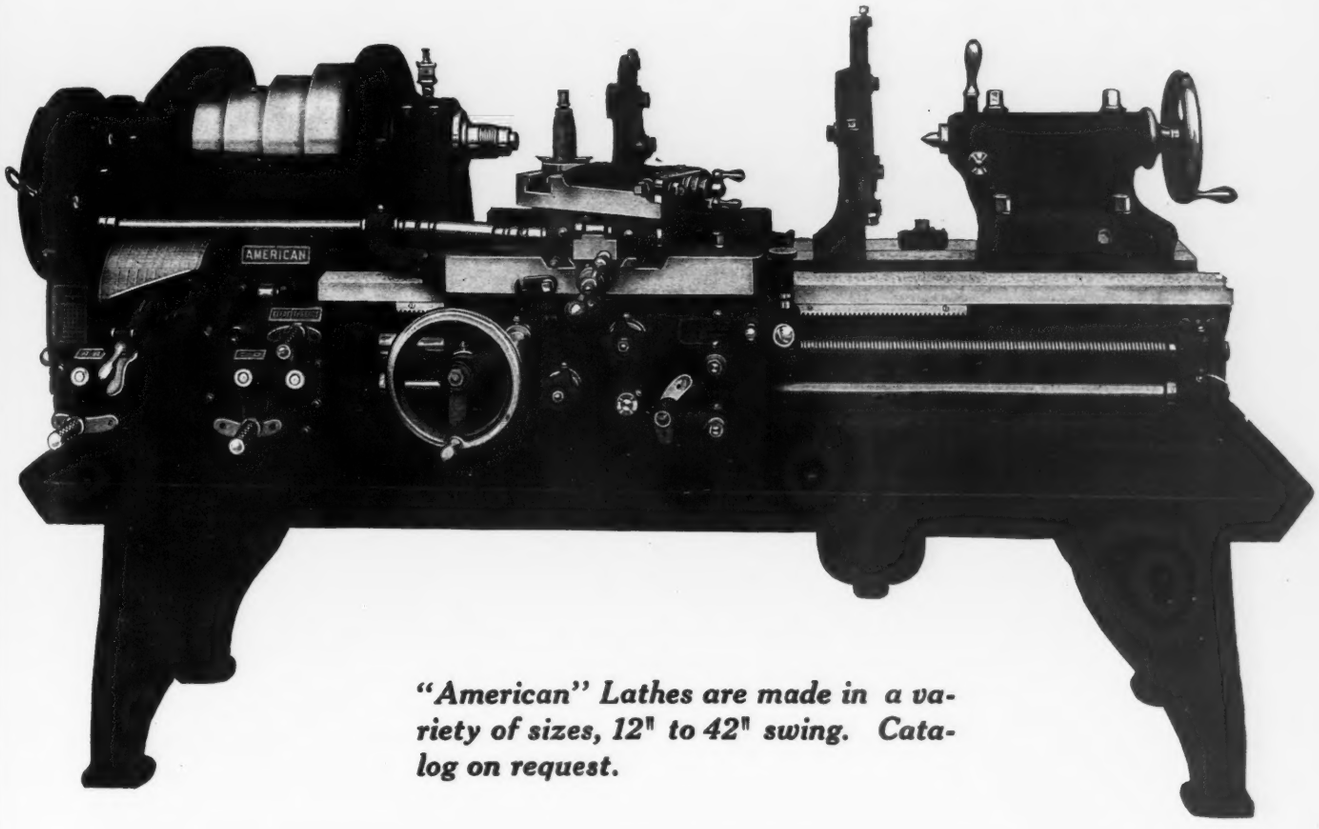
LATHES PLANERS

SHAPERS **AMERICAN** RADIALS

Tool-room to Heavy Duty, All "American" Lathes Satisfy

"Trouble is easier prevented than overcome." The reason complaints are rare from users of "American" Lathes is that we eliminate the trouble before it has a chance to develop. Every machine in the line is manufactured with highly accurate jigs and tools and assembled by experienced machinists; *every bearing surface is tested with templets, straight edges, tissue paper pulls, queen's levelers and other highly accurate devices specially designed for the purpose.*

In addition, we give a running try-out to each individual feed and thread. "American" Lathes *do* satisfy. Ask any user you meet.



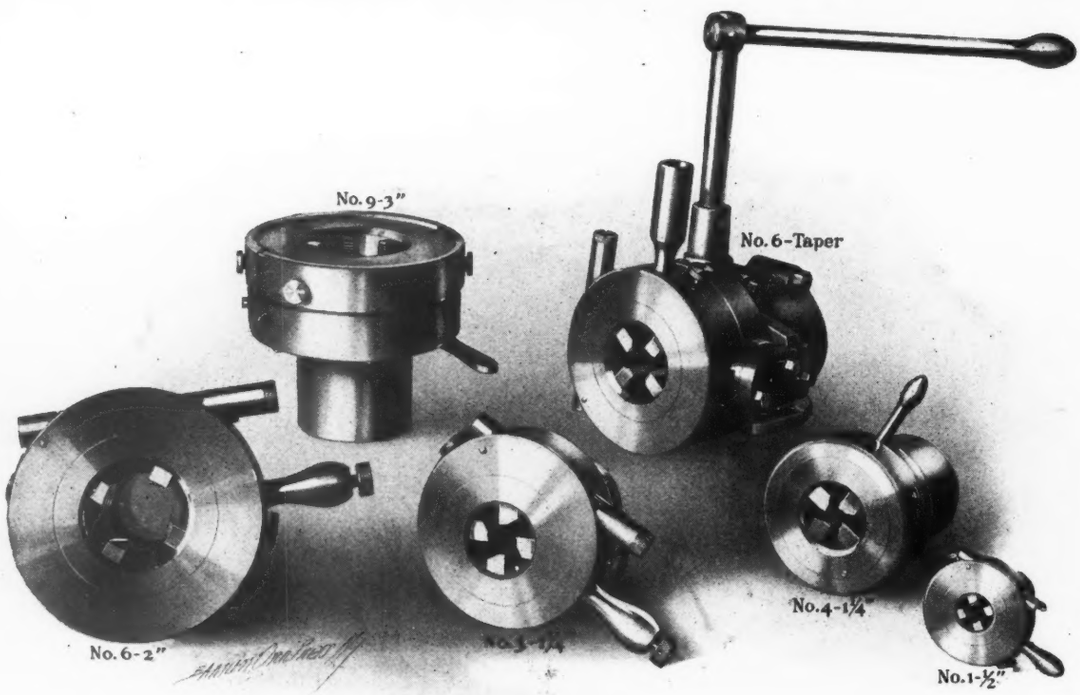
"American" Lathes are made in a variety of sizes, 12" to 42" swing. Catalog on request.

THE AMERICAN TOOL WORKS COMPANY

CINCINNATI, U. S. A.

SHAPERS RADIALS

—and the 3500th was a fine piece of threading



A representative group of Hartness Automatic Dies —

Read the letter on the opposite page. Mr. Hawke sent it to us entirely without solicitation or foreknowledge on our part. It is convincing evidence of the regard in which Hartness Automatic Dies are held by the Bessemer Gas Engine Company.

There is little mystery or luck in the good results obtained. We have succeeded by hard work in banishing these two uncertain elements from the manufacture of our dies and chasers.

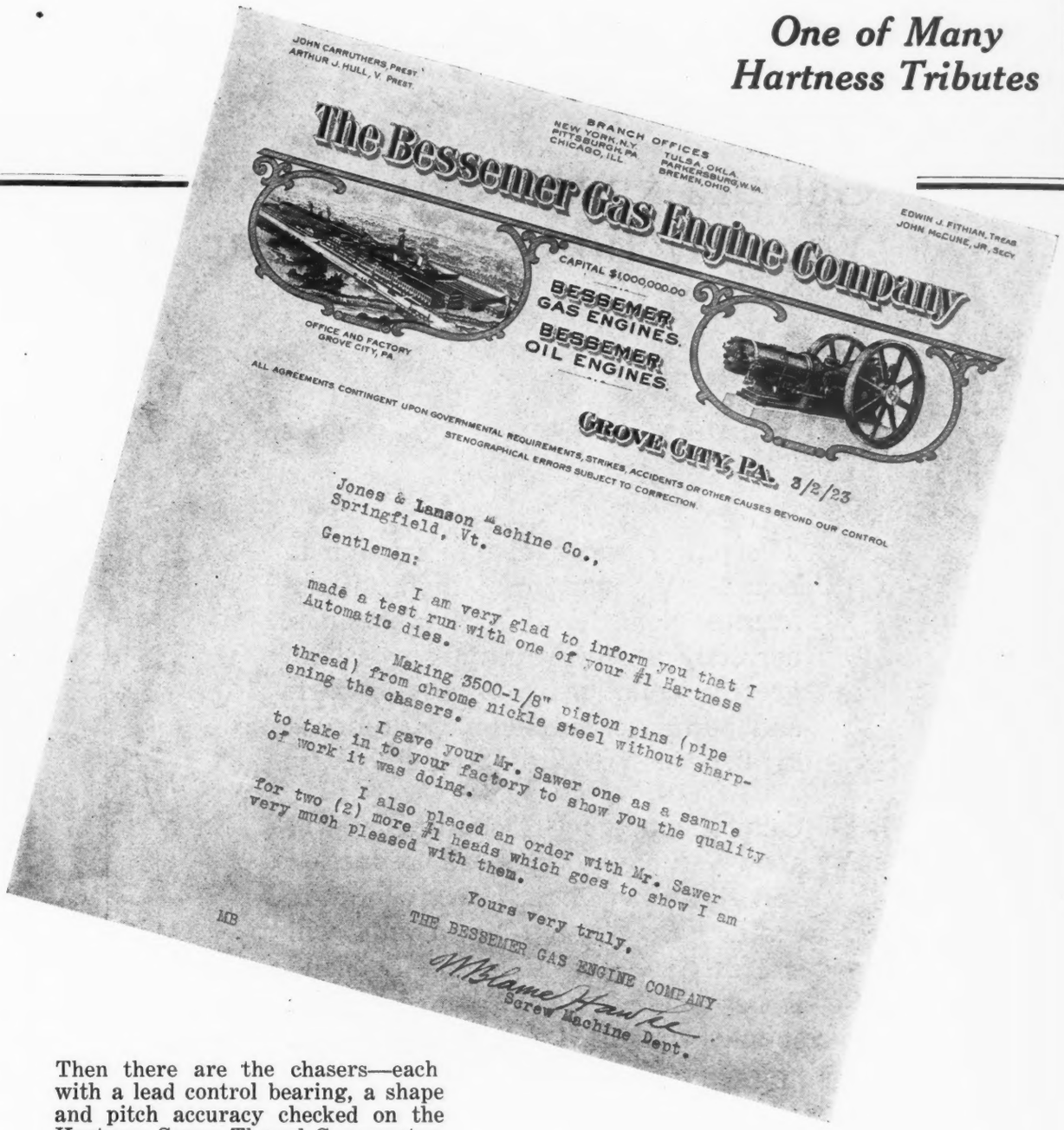
A rugged, durable Die-Holder is the first essential. The disc cam holds the chasers to their work right over the cutting edge—the stiffest way of the cross-section. It gives a cutting control, and an accuracy and durability of cutting edge not otherwise obtainable.

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San Francisco, California
503 Market Street
AGENTS:
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Mitsui Co., Ltd., Tokio
France, Spain and Belgium—F. Auberty & Co., 182 Rue Lafayette, Paris
Australasia—McPherson, Pty., Ltd.
554 Collins St., Melbourne

JONES & LAMSON

SPRINGFIELD,

One of Many Hartness Tributes



JOHN CARRUTHERS, PREST.
ARTHUR J. HULL, V. PREST.

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NEW YORK, N.Y.
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BREMEN, OHIO.

The Bessemer Gas Engine Company

EDWIN J. FITHIAN, TREAS.
JOHN McCUNE, JR., SECY.

CAPITAL $1,000,000.00

BESSEMER GAS ENGINES.
BESSEMER OIL ENGINES.

OFFICE AND FACTORY
GROVE CITY, PA.

ALL AGREEMENTS CONTINGENT UPON GOVERNMENTAL REQUIREMENTS, STRIKES, ACCIDENTS OR OTHER CAUSES BEYOND OUR CONTROL
STENOGRAPHICAL ERRORS SUBJECT TO CORRECTION.

GROVE CITY, PA., 3/2/23

Jones & Lanson Machine Co.,
Springfield, Vt.

Gentlemen:

I am very glad to inform you that I made a test run with one of your #1 Hartness Automatic dies.

Making 3500-1/8" piston pins (pipe thread) from chrome nickle steel without sharpening the chasers.

I gave your Mr. Sawer one as a sample to take in to your factory to show you the quality of work it was doing.

I also placed an order with Mr. Sawer for two (2) more #1 heads which goes to show I am very much pleased with them.

Yours very truly,
THE BESSEMER GAS ENGINE COMPANY
W. Blaine Hawke
Screw Machine Dept.

MB

Then there are the chasers—each with a lead control bearing, a shape and pitch accuracy checked on the Hartness Screw Thread Comparator, and a choice of material and heat treatment kept constantly abreast of the progress of the art.

Isn't all this what you want in a die?

MACHINE COMPANY

VERMONT, U.S.A.

Branch Office:
London, England
9-10 Water Lane, Queen Victoria St.

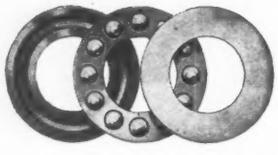
AGENTS:

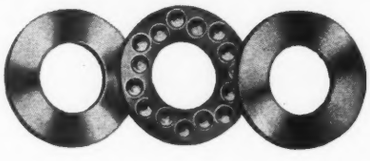
Holland—Spliethoff, Beeuwkes & Co.
Luevehaven, Wz., 159 Rotterdam

Sweden—A. Bol. Oscar Lindbom
Stockholm—Post Box 420



Get an Expert's Estimate on Your Friction Cost per Year





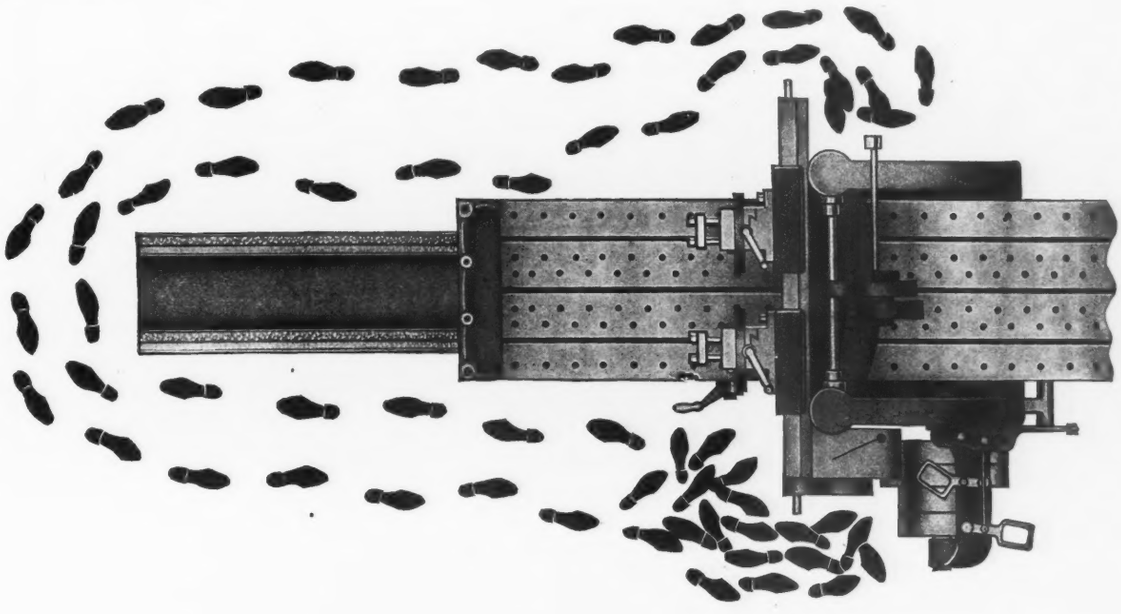
The power waste due to friction in bearings is amazingly high in the average plant. Anti-friction bearings, correctly placed, lower the power loss, greatly reduce wear on moving parts and permit continuous operation at high speeds without loss of efficiency.

Our Engineering Department will show you how to increase production and at the same time lower operation costs. Results in other plants will interest you—estimates on Ball and Roller installations in your own plant should convince you that efficient power transmission pays. Write us.

The Ball & Roller Bearing Company

Danbury, Conn., U. S. A.





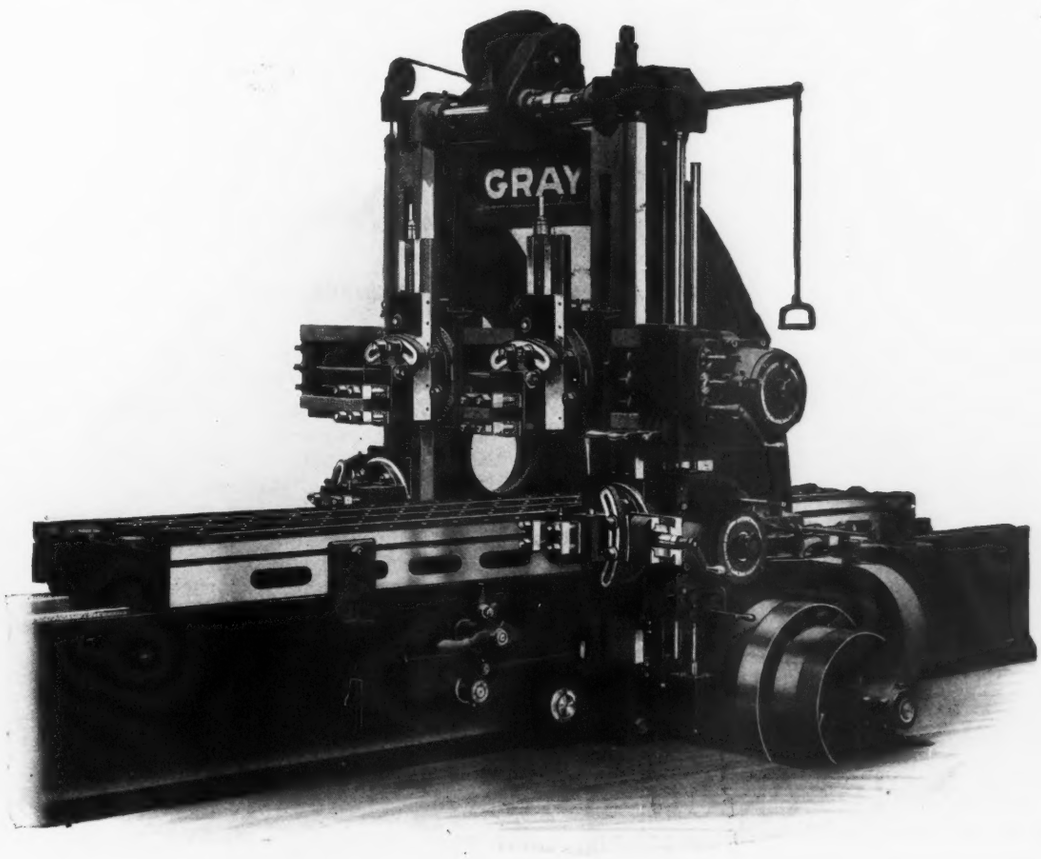
Why perambulate? Get a

GRAY MAXIMUM SERVICE PLANER

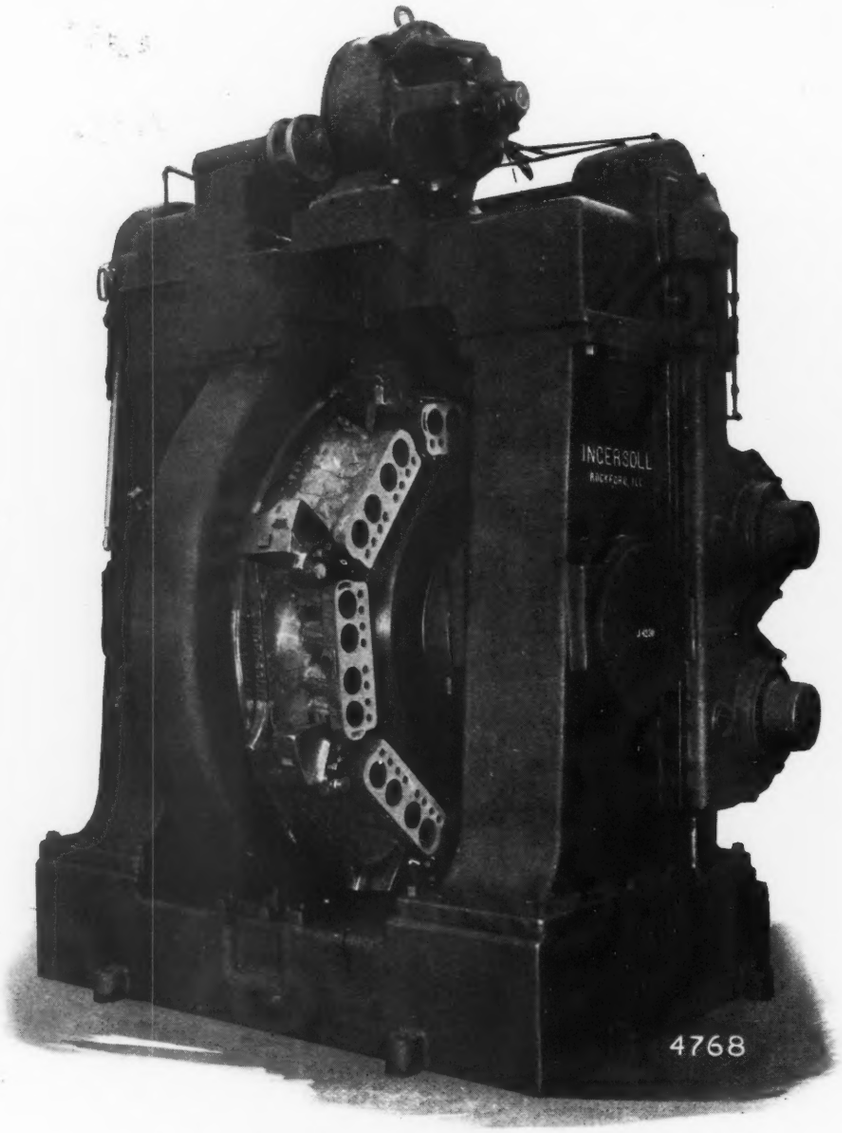
Complete centralized control is only one of the many distinctive features of these "super planers."

Write for our fully illustrated catalog which describes them all.

THE G. A. GRAY COMPANY, Cincinnati, Ohio



INGERSOLL



A 52,000-pound Ingersoll Drum Type Milling Machine
(Patented)

This Ingersoll Double Row Drum Type Continuous Milling Machine was built to take heavy roughing cuts and at the same time very accurately finish mill the top and bottom of cylinder blocks. It was built for this particular operation, having two sets each of eight special Ingersoll Fixtures, one set on either side of the heavy center drive worm wheel. The fixtures on the right of this worm wheel hold the castings while the tops of the blocks are milled and the set on the left when the bottoms are milled. It has massive sections and large diameter shafting to carry the power without loss or chatter to the cutters. It stands 11½ feet high and covers only 73 square feet of floor space.

Being the pioneer builders of the drum type continuous milling machines, we have acquired a fund of experience which is at your service in solving your production milling problems. Send us your blueprints with the production required, and without obligation we will recommend the equipment necessary to get this production.

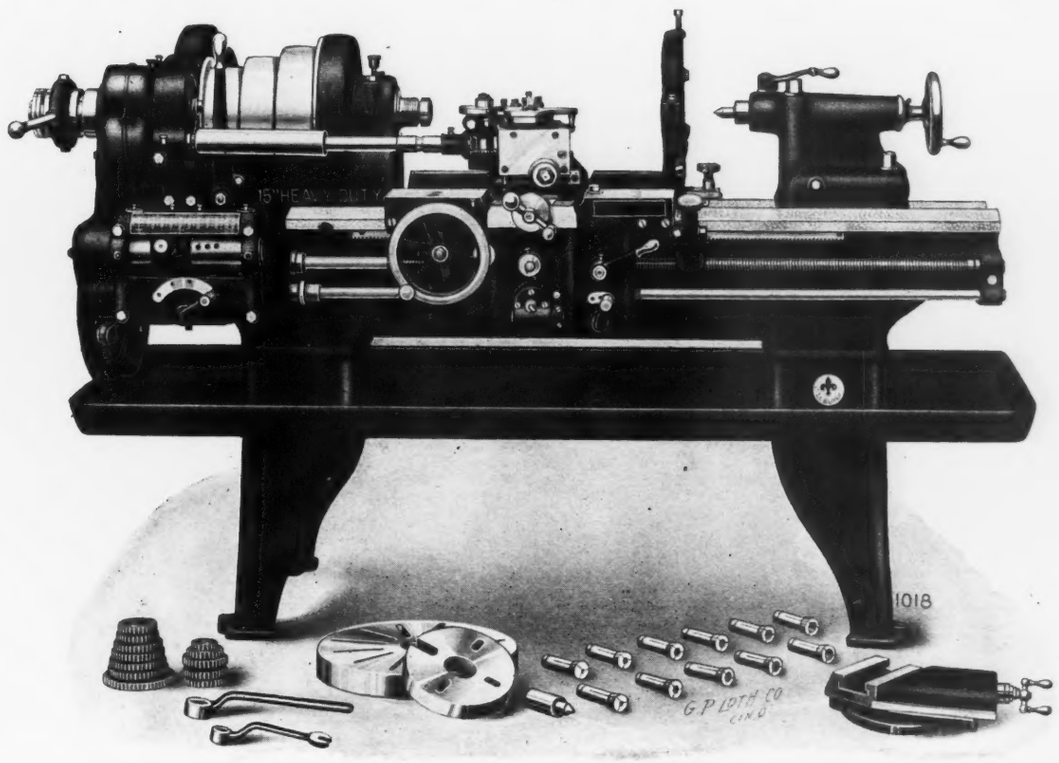
Bulletin No. 38, "Ingersoll Milling Cutters"
39, "Ingersoll Continuous Milling Machines"
40, "Ingersoll Installations of Milling Equipment"
42, "Ingersoll Drum Type Continuous Milling Machines"
43, "Ingersoll Face Milling Cutter Grinders"

The Ingersoll Milling Machine Co.

Milling Machines and Their Equipment

Detroit: David Whitney Bldg. ROCKFORD, ILL. **50 Church Street, New York**

THE
LE BLOND
HEAVY DUTY
PRECISION TOOL-ROOM LATHE



We offer for the most exacting tool-room service our newly developed 15" Heavy Duty Lathes with any or all of the attachments required for tool-room practice.

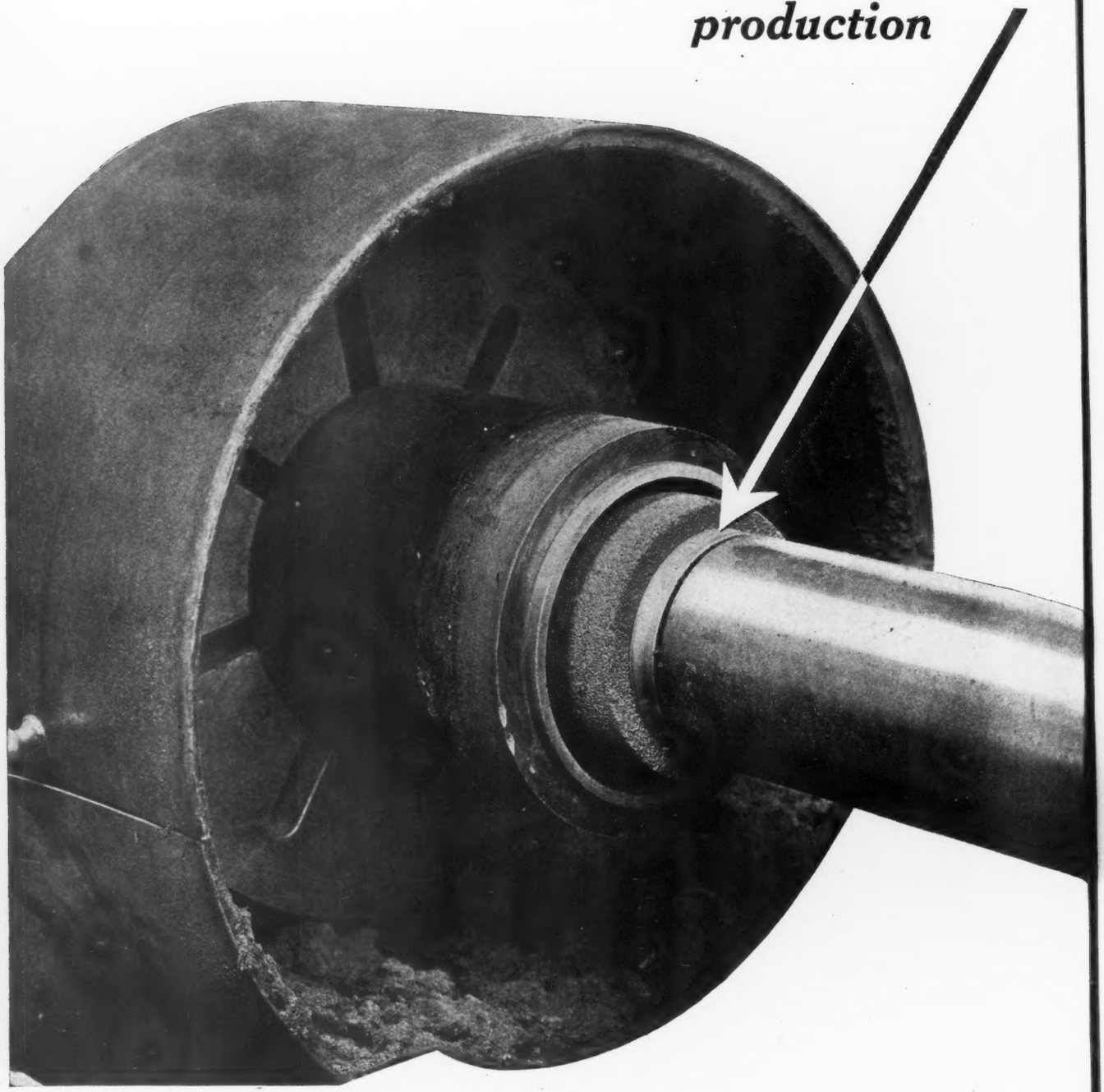
These lathes are built to the highest standards of accuracy and with the utmost care. A complete system of jigs, fixtures, gauges and thread standards are used in their production and tests, and each lathe must be within our close standards of inspection. They are exceptionally accurate, rigid and convenient, and in addition they have a capacity for heavy service, without impairing this precision, not found in other tool-room lathes. The lead screws are cut on a special lathe, equipped with a master screw, and are guaranteed as precision lead screws for exacting tool-room requirements. All parts are scraped to master surface plates, and all approved systems of gauging and measuring are used to determine the accuracy and adhere to our established close standard of precision.

The fundamental requirement of a successful tool-room lathe is accuracy, and this accuracy can only be retained during long service by correct design and the proper selection of materials. The Heavy Duty features of our tool-room lathe contribute materially to their precision and long productive life without interfering with their convenience and ease of operation. The lathe can be furnished with single pulley drive geared headstock, double friction back geared headstock with three-step cone, or motor drive from constant speed alternating or direct current motors.

The R.K. Le Blond Machine Tool Co.
Cincinnati. Ohio.

It's the Power Deli v

Only the power delivered right here gives you production

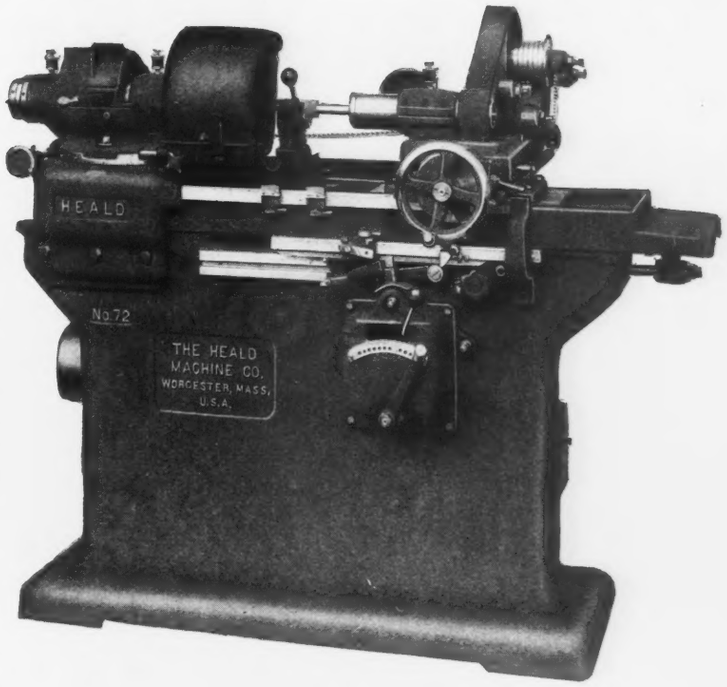


Grind with a HEALD and be Sure

li vered to the Wheel

That Counts

One is easily led to think that a grinder with a big motor or extra wide belt must give big production. It is a fact, however, that the number of horsepower a machine consumes, or the width of its drive belt, is no indication of the work it does. You may put 10 or more H.P. into a grinder and consume it all driving its mechanism.



The Heald Hydraulic Internal

however, is of such simple construction, having no gears, racks, etc., that loss due to friction is negligible. Therefore, practically every ounce of driving power goes directly into the wheel where it counts.

The Heald has proven in a recent competitive test that it produces a greater amount of accurate work at lower operating cost than any similar machine on the market today.

Production figures mean nothing in an advertisement. There are so many variable factors and conditions connected with each job that only by an actual test under normal working conditions can the results be obtained.

We stand ready to make that test, and while we are anxious and glad to send Bulletin No. 72, which describes the internal in detail, we suggest that you also

Get in touch with our Service Department and let us show you what we can do on your own work.

THE HEALD MACHINE COMPANY

16 New Bond Street, Worcester, Mass.

BRANCHES:

CLEVELAND, OHIO
614 Cleveland Discount Bldg.

CHICAGO, ILL.
9 South Clinton St.

MILWAUKEE, WIS.
947 41st St.

CINCINNATI, OHIO
614 Provident Bank Bldg.

NEW YORK, N. Y.
839 Singer Bldg.

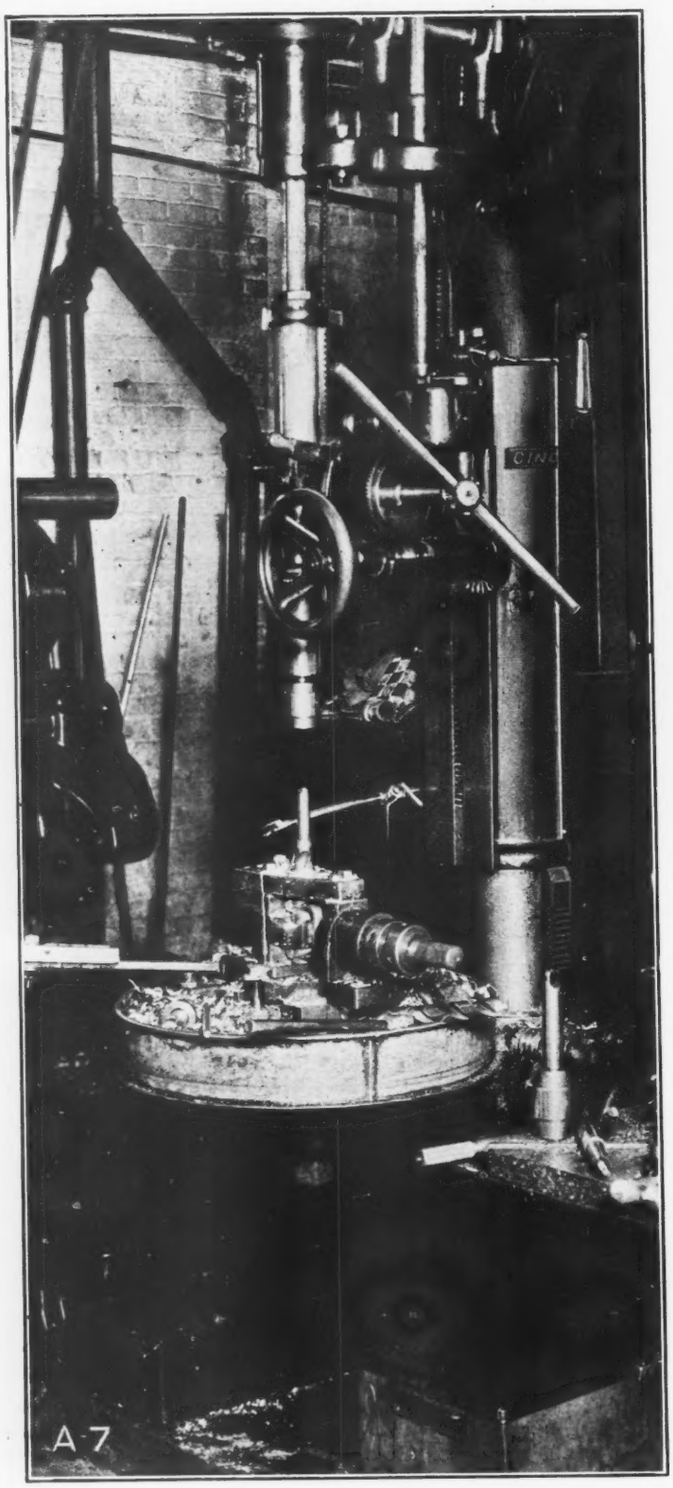
PHILADELPHIA, PA.
1302 Stephen Girard Bldg.

ST. LOUIS, MO.
709 Pontiac Bldg.

DETROIT, MICH.
400 Marquette Bldg.

Agents in all Principal Cities

Grind with a HEALD and be Sure



Severe Service a Joy to

THE CINCINNATI

UPRIGHT DRILL

The Studebaker Corporation, Detroit, Michigan, believes in forcing tools to their limit. The "limit" in this case was the tang of the drill which a CINCINNATI upright had just twisted off without apparent effort. The machine has stood up for years under just such service and is still in good condition.

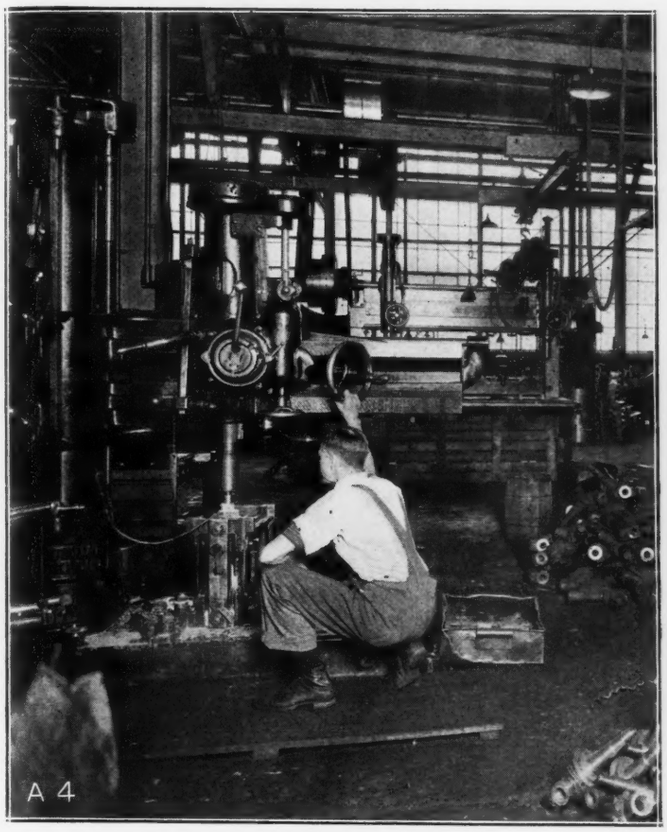
Is it any wonder that these tools are so popular, and that we should have grown to be the largest manufacturers of drilling machinery in the world? A good machine made by a reliable company and handled by responsible agents is bound to attain distinction.

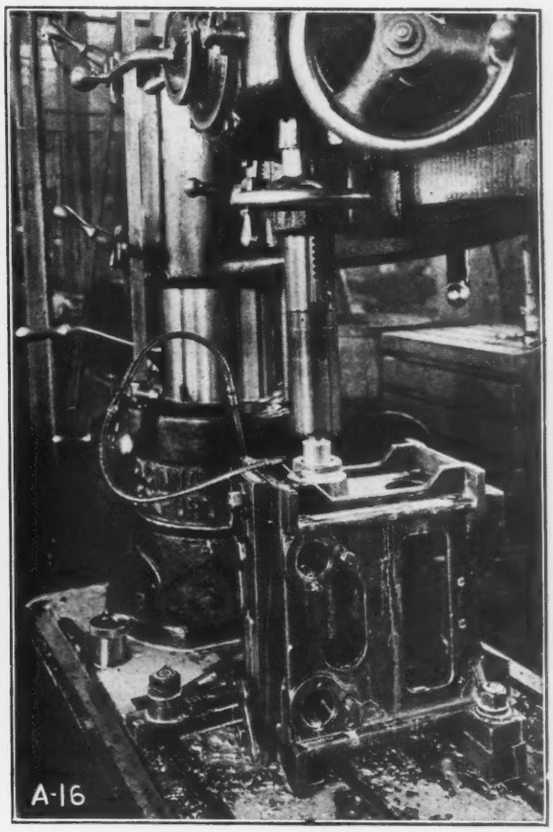
The CINCINNATI cuts chips cheerfully

The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

Founded 1874





Confined to an Inaccuracy of .001

The International Motors Company, Allentown, Pa., installed this CINCINNATI BICKFORD radial to drill drop-forged chrome nickel steel steering knuckles. The holes are 2⅛ inches in diameter by 12 inches in depth and are drilled at the rate of four per hour with a tolerance of but .001.

If our tools did not excel in accuracy and strength, such results would be impossible. The clamping of the column always alters the position of the arm to a greater or less extent—depending upon where the sleeve is slit. To drill a hole with a drill that is cramped in its bushing entails overheating, the scarring of the drill and bush, and obtaining a hole that is both rough and out-of-perpendicular.

Particular people pick precise presses

The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

Founded 1874

BETTS-BRIDGEFORD

Heavy Duty Engine Lathes

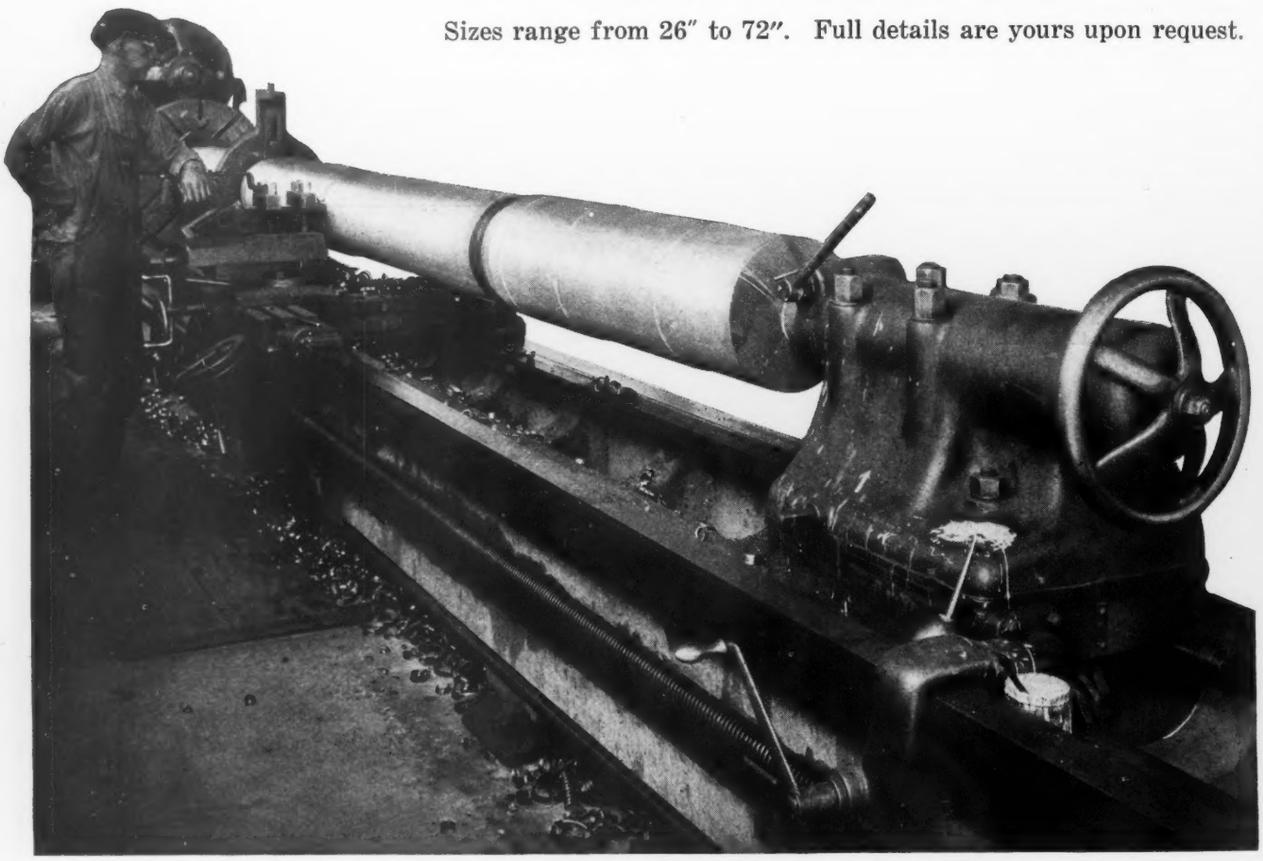
A Product of BETTS Machine Works

A Lathe may have strength enough to do a job but if it is not RIGID it is not the best machine for your work and more than likely will not stand up when the tough heavy jobs come along.

The weight of Betts-Bridgeford lathes is so distributed that the parts which are fixed and absorb the shocks are heavily constructed. They have the backbone, in other words, to take a lot of punishment and the sturdiness which keeps them producing continuously.

The illustration shows the kind of work Betts-Bridgeford lathes are called upon to do and they handle it in fast time. The geared headstock is self-lubricating, has all steel gears running in oil and all gear shifts are easy and convenient to make. The apron is of the one piece double wall construction and the tailstock is of heavy design and very easily moved along the bed.

Sizes range from 26″ to 72″. Full details are yours upon request.



WORKS:
Betts Machine Works
Rochester, N. Y.
Modern Tool Works
Erie, Pa.
Hilles & Jones Works
Wilmington, Del.
Newton Machine Tool Works
Philadelphia, Pa.
Colburn Machine Tool Works
Cleveland, O.

CONSOLIDATED MACHINE

OF

General Office: 17 E.

CONSOLIDATED

MODERN
Plain Cylindrical Grinders

Accuracy and quantity production are two terms much talked about, especially in the automotive industries and other large manufacturing plants where parts are turned out in great quantities.

It is on this kind of work that Modern Plain Grinding Machines have made exceptional records. On quantity production and in the tool-room they have demonstrated that they will stand up and maintain their accuracy under the most severe conditions. In other words they are correctly designed and the weight is properly distributed.

They are built in 8 sizes—8″x18″, 8″x30″, 12″x36″, 12″x48″, 12″x60″, 16″x36″, 16″x 48″, 16″x60″. If your work is such that it can be done on a plain grinder refer it to our engineering department. They have solved many a puzzling problem.



Note the heavy construction of the bed, wheel drive, and footstock in the illustration where it is shown grinding pistons. They can do a great quantity of similar operations.

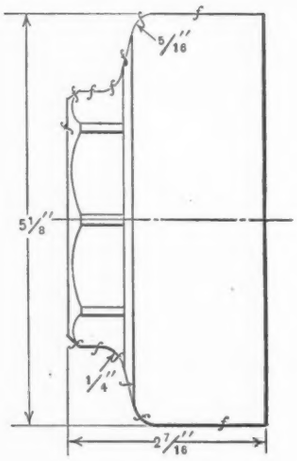
TOOL CORPORATION
AMERICA
42nd Street, New York

DISTRICT SALES OFFICES:
CLEVELAND
CHICAGO
DETROIT
NEW YORK
PHILADELPHIA
PITTSBURGH
ST. LOUIS

MACHINE TOOLS



A Typical Cincinnati-Acme Performance



Bronze Hub Caps for Cunningham Cars

James Cunningham, Son & Company, Rochester, N. Y., put bronze hub caps on Cunningham cars; turn them up on a Cincinnati-Acme Turret Lathe; machine them accurately and economically and with a comparatively small expenditure for the simple tools required.

Operations are as follows:—

1. Finish face; radius and bevel end.
2. Turn diameters; face ten degree angle portion.
3. Finish 5/16″ radius.
4. Finish ¼″ radius.
5. Finish turn outside diameter.

From 3/32″ to ⅛″ material is removed. Production seven per hour.

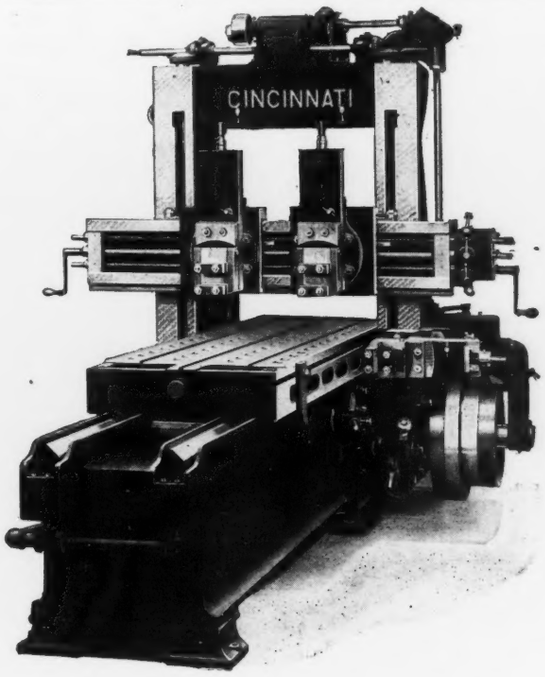
Let us show you what Cincinnati-Acme Machines can do for you.

THE ACME MACHINE TOOL CO., Cincinnati, Ohio, U.S.A.

Flat Turret Lathes ***Screw Machines*** ***Turret Lathes***

AGENTS

Henry Prentiss & Co., Inc., New York City, Boston, Buffalo, Rochester, Syracuse and Hartford.
Motch & Merryweather Machy. Co., Cleveland, Detroit, Pittsburgh and Cincinnati.
Marshall & Huschart Machy. Co., Chicago, Ill.
Marshall & Huschart Machy. Co., of Indiana, Indianapolis, Ind.
Robinson, Cary & Sands, St. Paul and Duluth, Minn.
Elliott & Stephens Machy. Co., St. Louis, Mo.
W. E. Shipley Machy. Co., Philadelphia, Pa.
Kemp Machinery Co., Baltimore, Md.
Seeger Machine Tool Co., Atlanta, Ga.
Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.
Dewstoe Machine Tool Co., Birmingham, Ala.
Harron, Rickard & McCone, San Francisco and Los Angeles, Calif.



CINCINNATI BORING MILLS

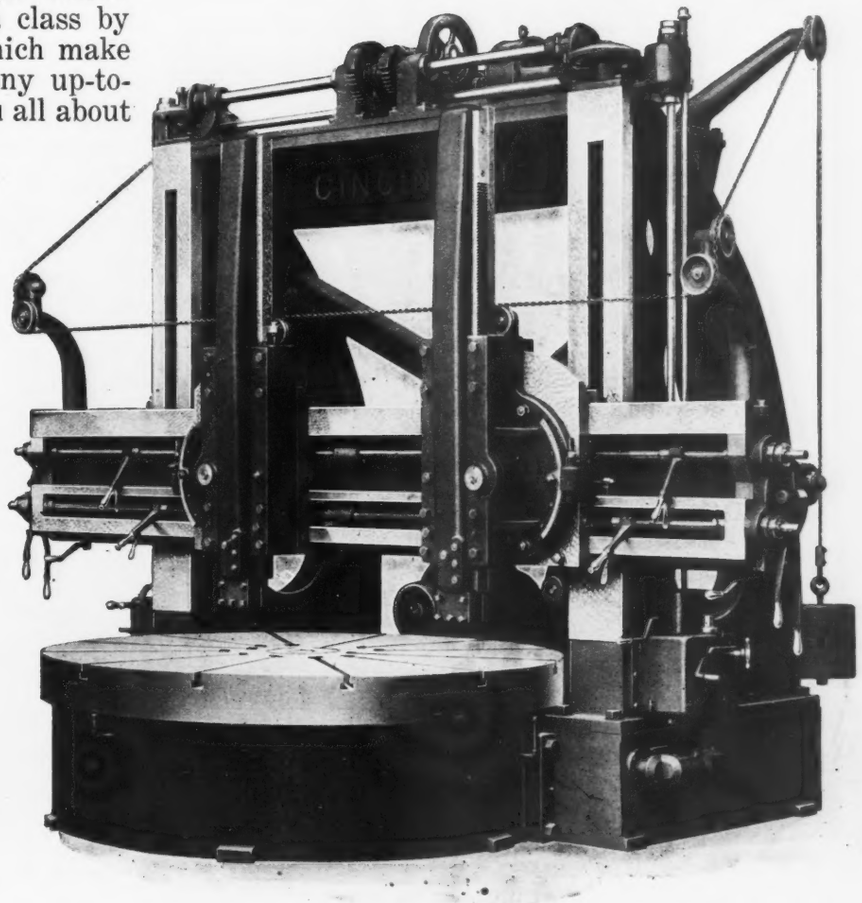
Capacities 2" Over Rated Size

Power, rigidity and convenience are all developed in generous measure in these machines; and they *don't* require big, husky operators to run them. The Rapid Power Traverse, with adjustable control levers, and the centralized location of all handles, dial plates, indices, etc., within easy reach and view from working position make the actual manual labor of operation an easy task. Designed and built to permit average men in average shops to make machining time most productive in the widest possible range and variety of work.

CINCINNATI PLANERS

Always come to mind when Rapid Power Traverse is mentioned.

Machines which have herringbone gears, box arch, forced lubrication and other advantages which put them distinctly in a class by themselves. Machines which make profitable additions to any up-to-date shop. Let us tell you all about them.



Rapid Production Mills 42", 48", 60", 72", and 84" Sizes. Massive Mills, 8', 10', 12', and 10' x 16'.

Bulletins on request.

THE CINCINNATI PLANER COMPANY

CINCINNATI OHIO, U. S. A.

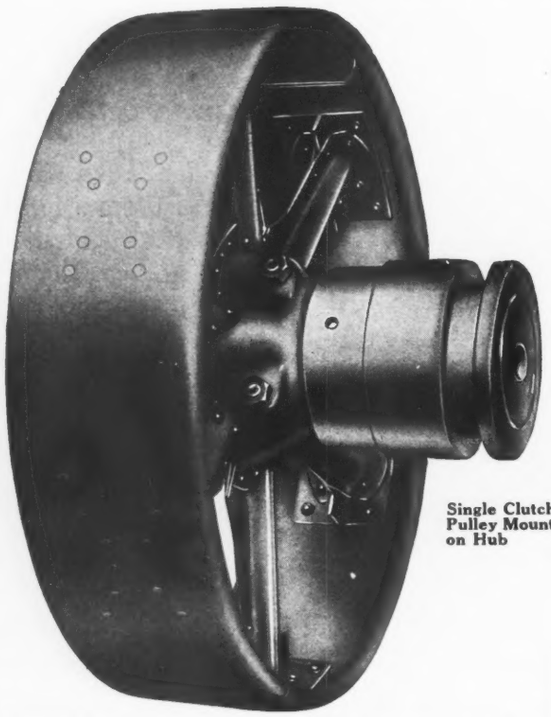
Manufacturers of

Planers and Boring Mills

THE JOHNSON FRICTION CLUTCH

as used on the

"New" Semi-Automatic Multiple-Spindle Cylinder Boring Machine



Single Clutch Pulley Mounted on Hub

The cylinders are mounted on a rotary fixture having six positions, five working and one loading. The loading and unloading is done while the machine is in operation.

The machine has five spindles which provide for taking all five cuts at the same time in separate cylinders.

The *Johnson Friction Clutch* is used on this machine to control these operations. The shifting lever is placed at the front of the machine where it is handy to the operator.

The *Johnson Clutch* gives perfect control over the machine at all times.

Consider some of the advantages of having friction control on the machine rather than the old way of operating machinery.

Positive control with a lever in front of machine.

Operating lever on a level with the hand. No reaching overhead as with a countershaft.

Elimination of the shifting belt nuisance. The belts last longer and edges are not curled over nor worn off.

Direct drive from lineshaft, that requires the minimum quantity of belting.

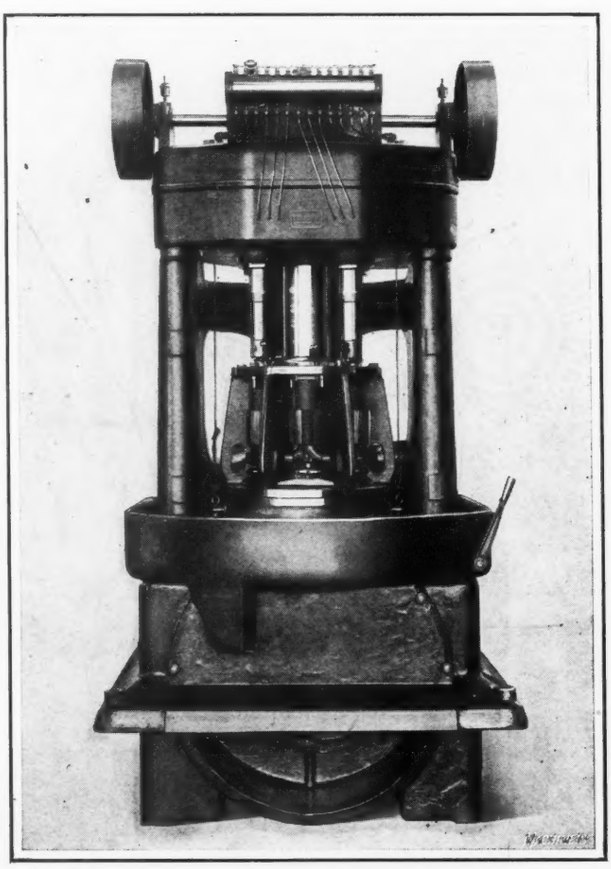
The Johnson Clutch is an asset to any machine and not an expense.

Be sure it's a *Johnson.*

Standard Clutches carried in stock in a multitude of sizes.

Write for stock list.

Catalog "A" should be in your files. May we send you a copy?



Courtesy: Manufacturers Consulting Engineers, Syracuse, N. Y.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

Look this High Speed Drill Over



It is a

"Morse" Product

Every Experienced Mechanic Knows What That Means.

THE GENUINE MORSE DRILLS ENCIRCLE THE GLOBE

Made in New Bedford
Used Everywhere

MORSE
TWIST DRILL & MACHINE CO.
NEW BEDFORD, MASS., U.S.A.



Drill Faster and Truer

Cut down the cost per hole



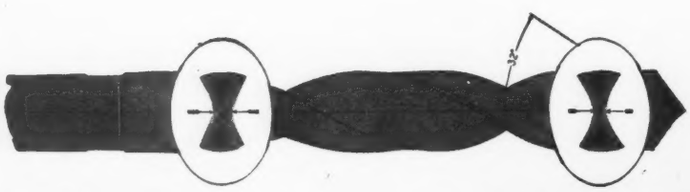
For drilling drop forgings or hard alloy steel castings, specify Double-D Rolled Drills, and after a reasonable time compare the results with present production costs. This test shows up more clearly than any other the real superiority of Double-D's.

They combine the strength of the forged drill with the accuracy and uniformity of the milled type. The rolling process—which we control exclusively—gives greater density to the steel without introducing the rough inaccuracies of hammering.



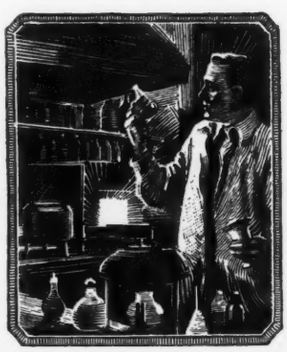
Try Double-D Drills on the toughest job in your plant and watch them "hog in".

We invite comparative tests.



The wide flute insures ample chip clearance for deep drilling.

Double-D hot rolled drills now available in sizes from ¼" to 1⅝"



Detroit Twist Drill Co., Detroit, Michigan

45 Warren Street, New York **Metropolitan Building, Atlanta**

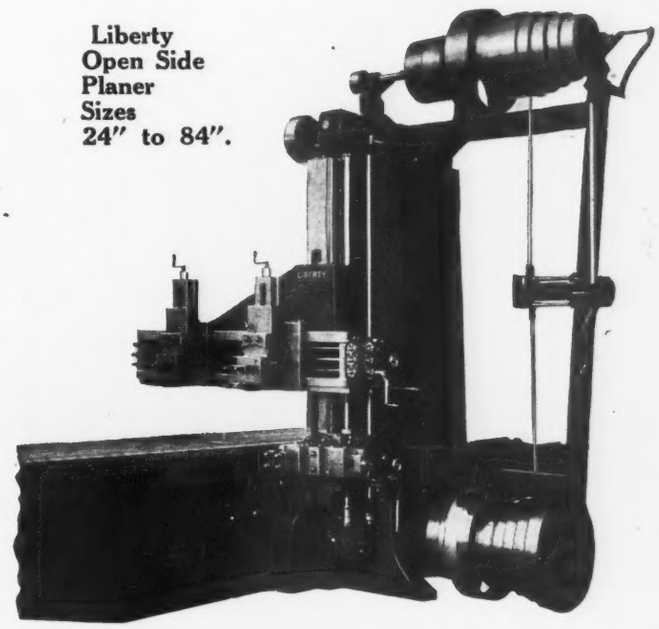
Canadian Detroit Twist Drill Co., Limited, Walkerville, Ontario

(54)

DETROIT DOUBLE-D ROLLED DRILLS

If it's a Liberty —you will have every feature essential to a modern high grade planer

First: plenty of speed, plenty of power and a high degree of accuracy.



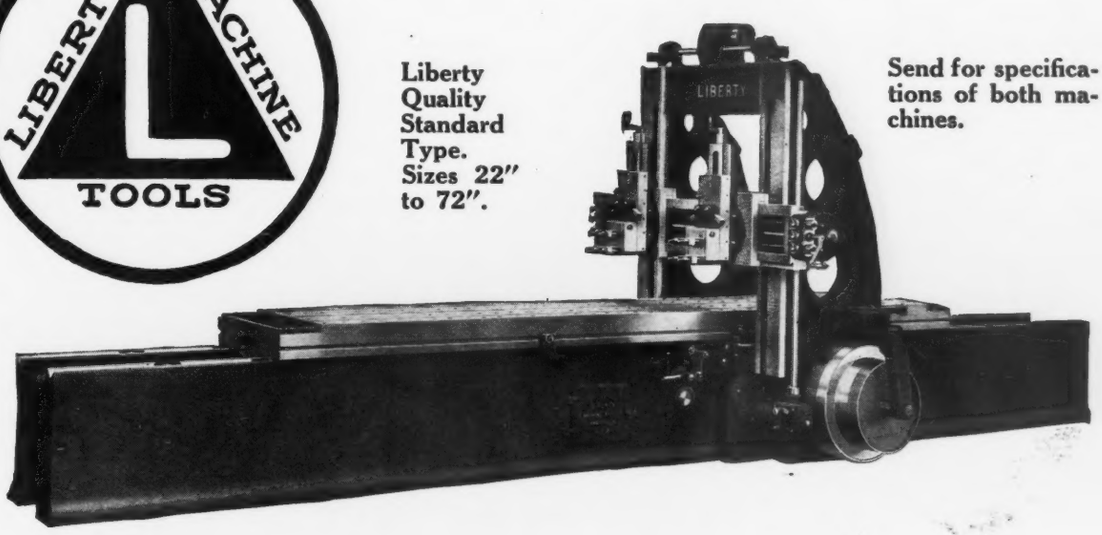
Liberty Open Side Planer Sizes 24" to 84".

Then these special features: A feed mechanism that enables the operator to control or change the feed of any head at any time without stopping the machine or disturbing the other heads (Liberty Patent), a conveniently located dial that enables the operator to set the feed without difficulty and to read it easily. Patented four speed belt drive, patented micrometer collars, patented clapper box clamp, etc.

Liberty Open Side Planer has individual advantages for handling big awkward pieces, heavy odd shaped castings or any other work that's hard and sometimes impossible to set up on a standard type planer.

LIBERTY MACHINE TOOLS

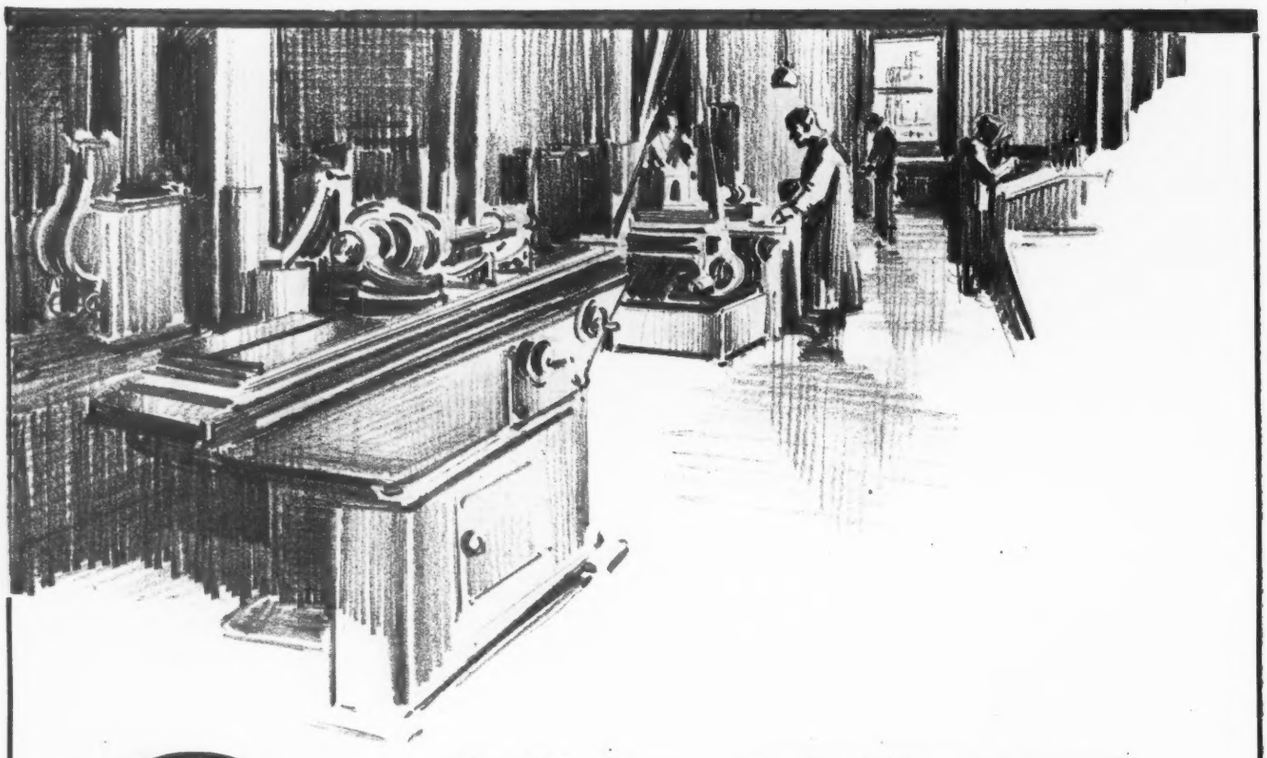
Liberty Quality Standard Type. Sizes 22" to 72".

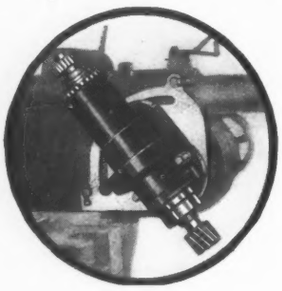


Send for specifications of both machines.

LIBERTY MACHINE TOOL COMPANY

HAMILTON, OHIO



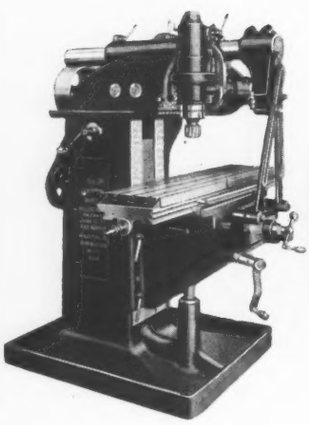




The Van Norman Duplex Miller is instantly adaptable to practically every milling requirement.

Adjustable cutter head and movable ram make it a simple matter to place the cutter in the most advantageous position relative to the work. Any number of different cuts can be made with but one clamping and carried through the full longitudinal movement of the table.

Users of the Van Norman Duplex regard it as an essential part of their tool-room equipment. It saves serious delays, heavy tool expenses, and unsatisfactory, makeshift jobs.



Van Norman
machine tool co.
SPRINGFIELD ~ ~ ~ ~ ~ MASS.

5413



A Dixon's Eldorado 4H is always a 4H—no matter whether you buy it in New York or San Francisco—this week or next year.

So with every one of the seventeen leads—from 6B, the very softest, to 9H, the very hardest.

Uniformity and faithfulness to grade are outstanding characteristics of this master drawing pencil.

DIXON'S ELDORADO

"the master drawing pencil"

JOSEPH DIXON CRUCIBLE COMPANY
Pencil Dept. 74-J Jersey City, N. J.
Canadian Distributors: A. R. MacDougall & Co., Ltd., Toronto

SAMPLE OFFER

Write for full-length free samples of *"The master drawing pencil"* and of Dixon's "BEST" Colored Pencils. In their field, the "BEST" Colored Pencils hold the same position of supremacy as Dixon's Eldorado.

DIXON'S ELDORADO ERASER

A worthy partner of Dixon's Eldorado pencil. Soft—pliable—yet firm enough to clean the drawing without crumbling into aggravating little bits. Made in 12 sizes. Write for a sample. Free on request.

NATIONAL SEMI-AUTOMATIC HAMMER HEADER

Produces More Bolts at Lower Cost

This machine runs continuously and the movements are automatic. The operator devotes all his time to feeding; and, as the machine sets the pace for operation, outputs are greatly in excess of those secured from the old style machines.

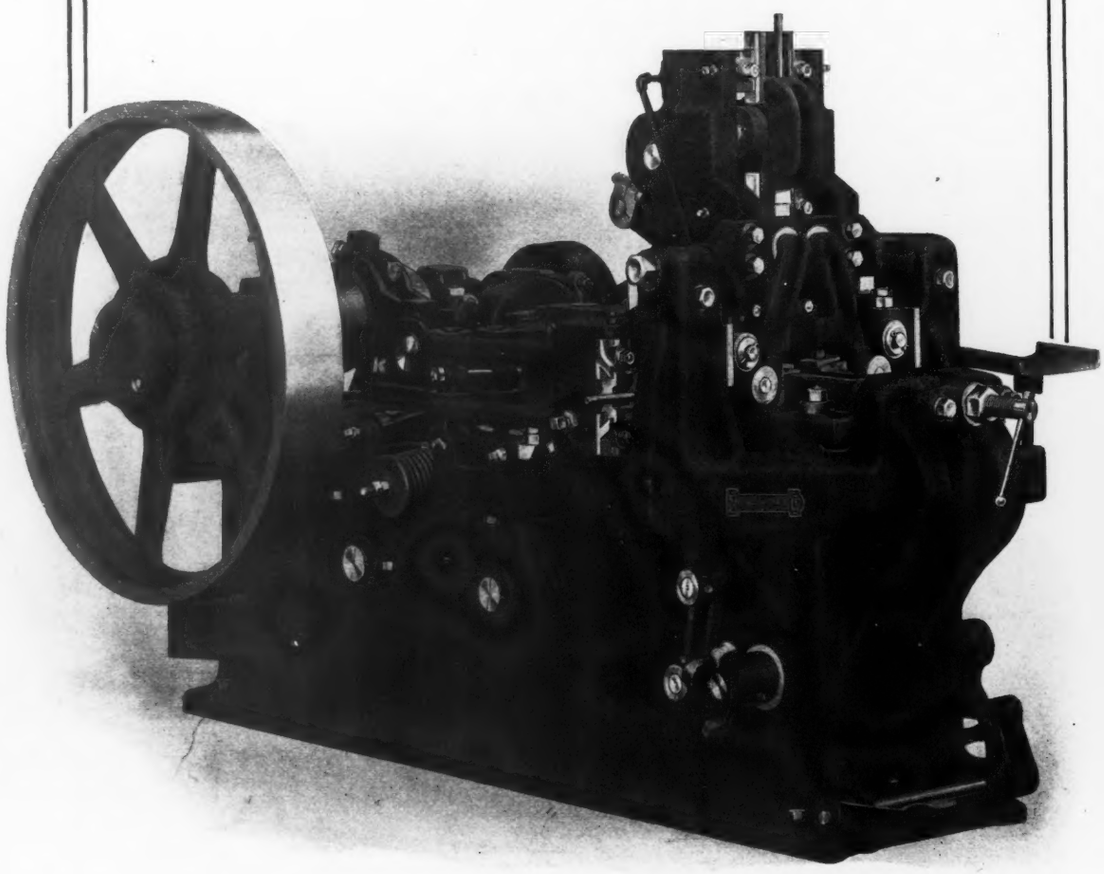
As each bolt is given the same predetermined number of blows, work is very uniform. Due to the rigid construction of the bed and working parts, a better bolt is produced in four blows than can be secured in six blows from previous designs.

Investigate the National Semi-Automatic Hammer Header for making your square, hexagon and T-head bolts. It will pay you.

We'll be glad to send full details.

The National Machinery Co.

TIFFIN, OHIO, U.S.A.



contex bakelite



silent, yet tough

ABOVE the roar of noisy machinery, engineers shouted for silent gears. Their answer is here—CONTEX. Gears made of CONTEX Gear Material are chatterless, rattleless and vibrationless—yet strong as iron. Absolutely unaffected by heat, cold, water, steam, solvents, many acids, rodents and weather conditions. Samples and descriptions ready for those really interested.

THE CONTINENTAL FIBRE COMPANY

(Licensed Manufacturers)

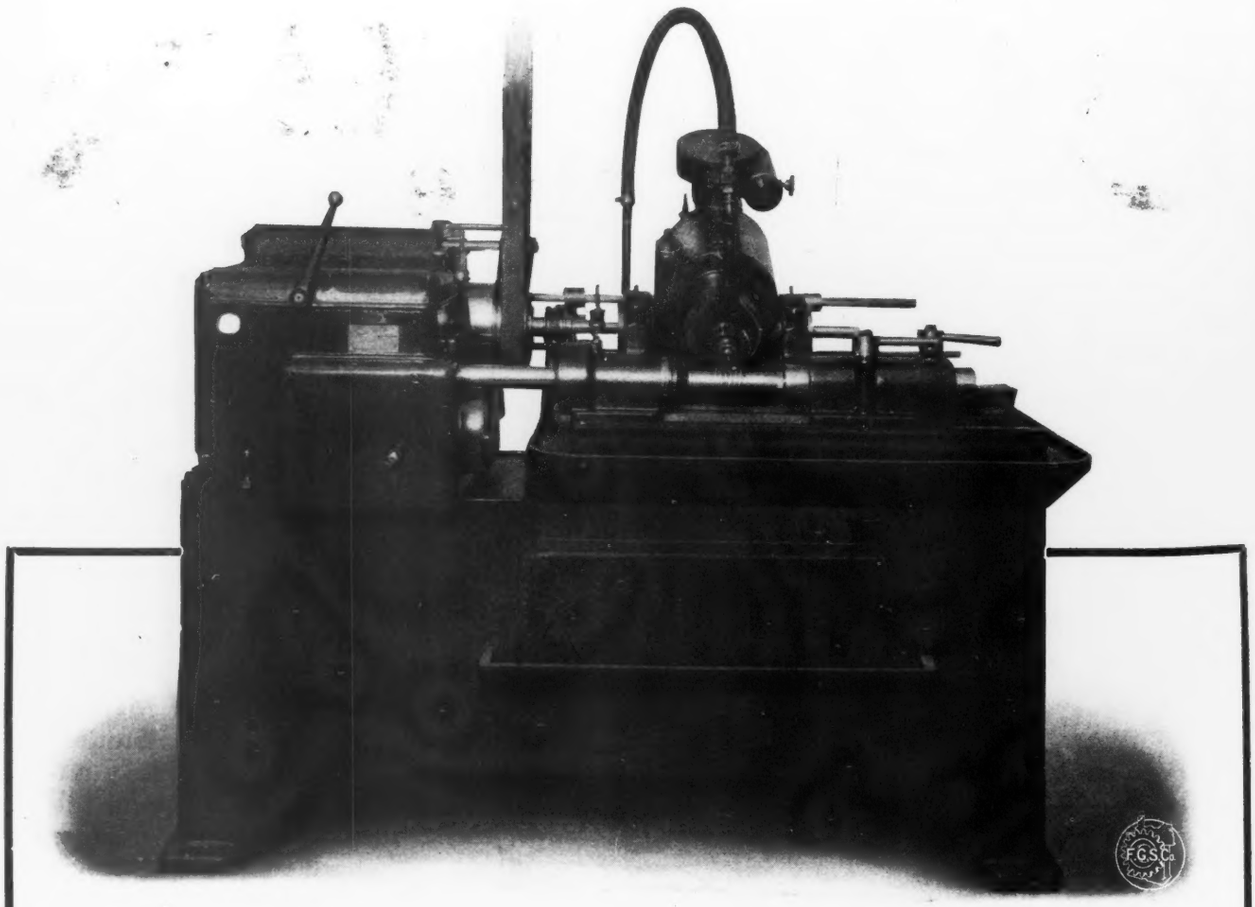
Factory: NEWARK, DELAWARE

Service on Contex, also Bakelite-Dilecto, Conite, Continental-Bakelite, and Vulcanized Fibre from:

New York.....233 Broadway
Chicago...332 S. Michigan Ave.
Pittsburgh.....301 Fifth Ave.
San Francisco...75 Fremont St.
Seattle.....95 Connecticut St.
Los Angeles....411 S. Main St.

makes mute gears

A Laminated Phenolic Condensation Material



Here it is—

The Machine you have been waiting for

A Thread Generating Machine having remarkable production possibilities.

It uses a helical Gear Shaper cutter and produces worm threads with an ease and dispatch that is almost startling.

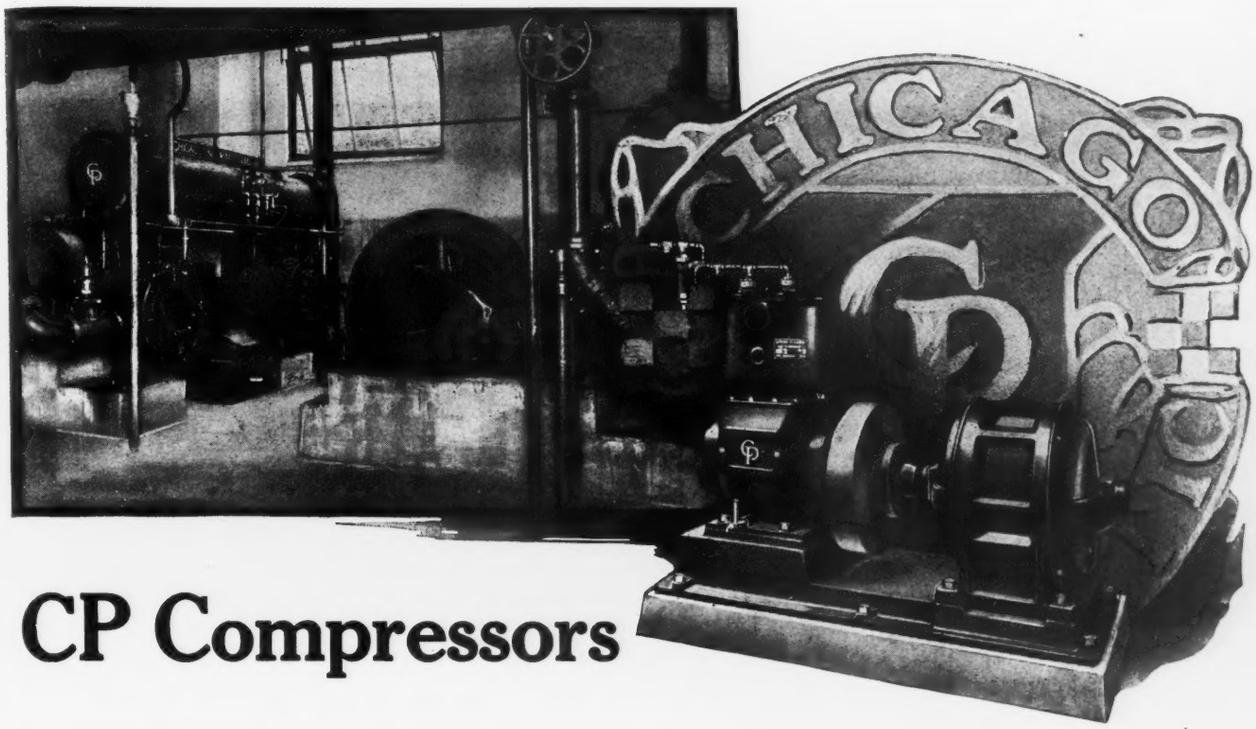
You can now generate worm threads anywhere from three to five times as rapidly as was ever possible before, and at the same time, get more accurate work.

A companion machine to the High-speed Gear Shaper, and another solution to the reduction of Labor Costs. If you cut threaded work in quantities, you will want one of these Thread Generators. Yes! We have a booklet that describes it completely. Do you want a copy?

The Fellows Gear Shaper Company

Springfield, Vermont, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India), Ltd., Head Office, Calcutta, India; Bohm & Bormann, Berlin, Germany. PACIFIC COAST REPRESENTATIVES: Eccles & Smith Company, Portland, Oregon; Seattle, Washington; San Francisco and Los Angeles, California.



CP Compressors

CP DIRECT CONNECTED, motor driven air compressors of the types illustrated are used by the United Electric Light and Power Company in their Hell Gate station and in sub-station service.

Public Service equipment must be reliable. Where CP Air Compressors are installed, apologies for their performance are unnecessary, as attested by thousands of satisfied users.

The valves are the heart of an air compressor. CP Air Compressors are equipped with Simplate (meaning simple plate) Valves which is the original flat disc valve. Their straight lift without bending or twisting affords maximum valve area resulting in high volumetric efficiency and low power consumption per unit of air actually delivered. Simplates reduce valve maintenance costs to a minimum.

Men who know have placed their approval on CP Air Compressors as being mechanically correct. Wherever installed you will find them maintaining their reputation for satisfactory performance.

Made in over 500 sizes and types for every compressed air need. What is yours? Bulletins upon request.

After all what users say counts most!

After nine years service one user says: "Regarding the performance of our CP Air Compressor purchased in 1913, we are much pleased with same. It has been in almost continuous operation since purchased and is still in first class condition."

Chicago Pneumatic Tool Company

6 East 44th Street, NEW YORK, N. Y.

*Sales and *Service Branches all over the World*

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*Boston	Denver	*Los Angeles	*Philadelphia	*San Francisco	Basle	*Buenos Aires	Helsingfors	Manila	Osaka	Santiago	Tampico	*Winnipeg
*Chicago	*Detroit	*Minneapolis	*Pittsburgh	Seattle	Berlin	Christiania	Honolulu	Milan	Paris	*Sao Paulo	Tokyo	
*Cincinnati	El Paso	New Orleans	Richmond	*St. Louis	Bombay	Dairen	Johannesburg	*Montevideo	*Rio de Janeiro	Seoul	*Toronto	

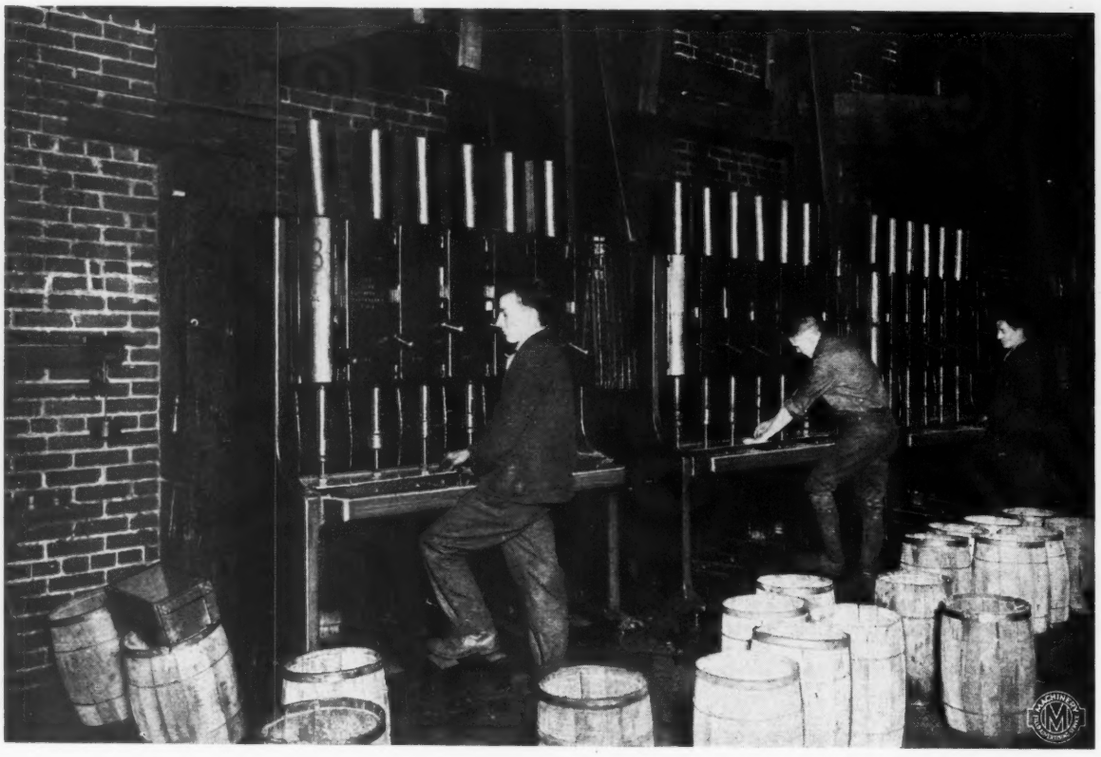
Canadian Pneumatic Tool Company, Montreal, manufacturers of Chicago Pneumatic products in Canada.

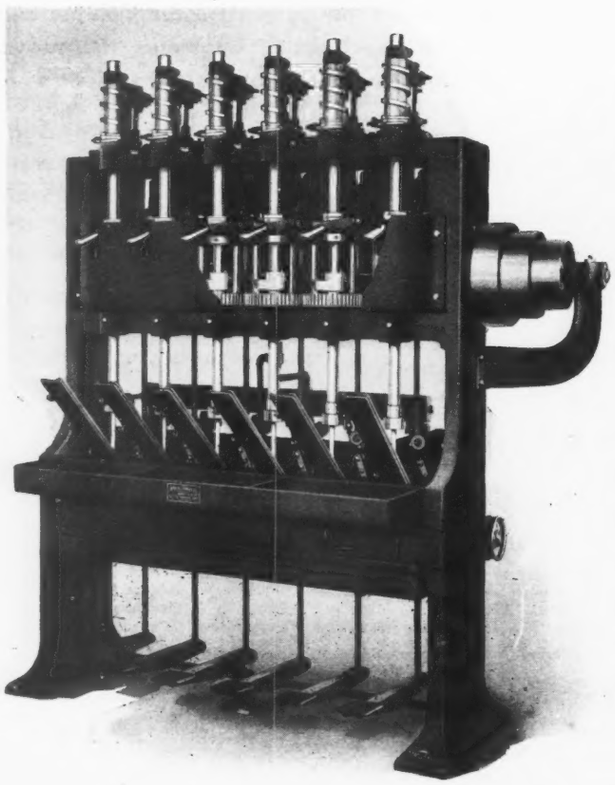
C-137

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES — ROCK DRILLS · · COAL DRILLS

CHICAGO PNEUMATIC

The Compressor with the Simplate Valve





Acme Nut Tapping Machines

Above is shown a battery of three Acme Six-spindle, Semi-Automatic Machines tapping 5/8″-11-pitch and 3/4″-10-pitch U. S. standard nuts—an average production of 12,000 being obtained per machine each 9-hour day.

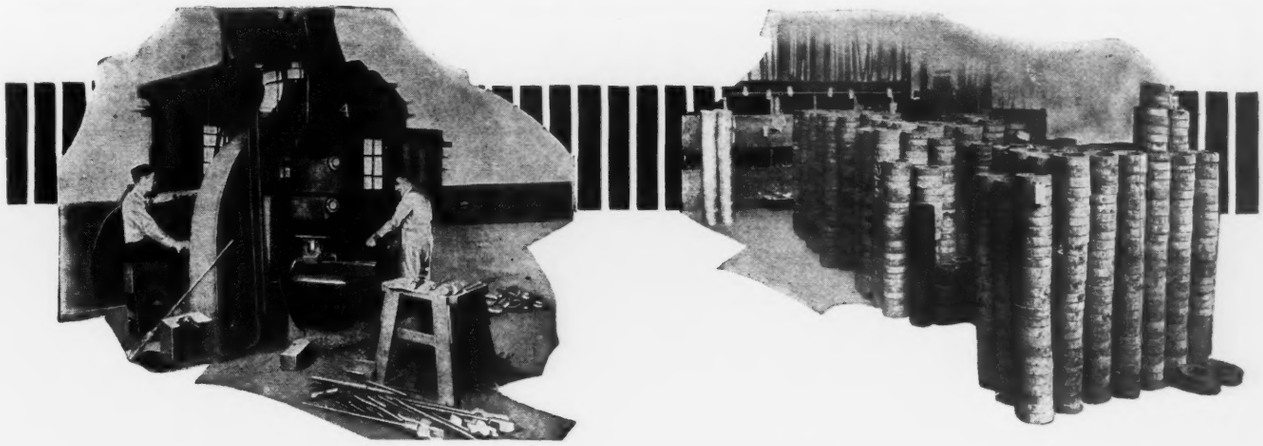
Acme Six-spindle, Semi-Automatic Nut Tappers are easily operated and speedy. Each spindle has automatic lifting device which permits automatic feed to place nut under cap.

Write for details

THE ACME MACHINERY COMPANY

CLEVELAND **OHIO, U. S. A.**

Foreign Agents: Burton, Griffiths & Co., Ltd., London. Glaenzer & Perreaud, Paris, France





Factors in Strom BALL BEARINGS Supremacy



No. 4—The Forge Shop

STROM ball-bearing-steel is hand forged—in our own forge shop—by a kneading process on steam hammers.

From the shearing of the slug to the finished forging blank absolute uniformity of weight and structure is efficiently achieved by the most modern forge shop equipment and practice. Fitting these exclusive devices and methods with certainty to our standard methods of heat treatment assures a finished STROM bearing of unified, wear-resisting quality.

Thus the STROM forge plant is another reason why STROM guaranteed ball bearings, for new or replacement work, leave wide open the gateway for Power—

"Wherever a Shaft Turns"

(1978)



An Organization Built for Precision

Scientific in Principle and Practice

MULTI-DRILLERS NATCO MULTI-TAPPERS
THE HOLE STORY IN ONE WORD

Moline Plow Company
Poole Engineering Company
Brown-Lipe-Chapin Company

Find NATCOS give maximum production on gear work

The advantages of a patented two speeds in the head arrangement, for drilling and tapping several holes simultaneously, have converted many manufacturers to NATCOS. The above firms find NATCOS profitable on gear work.

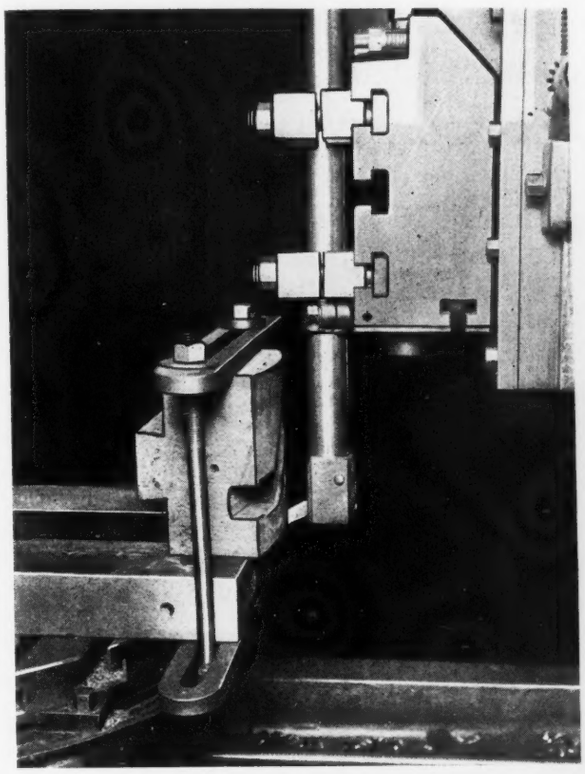
We will be pleased to show you how NATCO Multi-Drillers and Multi-Tappers can "gang the holes" on your work to your advantage. It costs nothing to find out. Send blueprints.

The National Automatic Tool Co.
RICHMOND, INDIANA

Largest Exclusive Manufacturers of Multi-Drillers and Multi-Tappers

"The Dill Slotter is Quicker"—

So They Use It for This Job





The Dill Slotter in the tool-room of a big industrial plant has a reputation as a time saver that brings it many unusual jobs. Take for instance, this drop hammer die: The operation now in progress (machining the working face to a 22" radius) while a typical slotter job was preceded by the roughing and finishing of the dovetailed shank, which is 3¼" wide by 1½" deep, with sides cut on an angle of 5 degress. This is a legitimate shaper job, but as the foreman said, "the Dill Slotter is quicker" and speed is important when you count production costs.

Dill Slotter accuracy, speed and convenience enable it to handle a wide variety of work with unusual efficiency; make it a profitable installation in all kinds of shops. Interesting construction details and operation details in the Dill Slotter Booklet—yours for the asking.

T. C. DILL MACHINE CO., Inc.

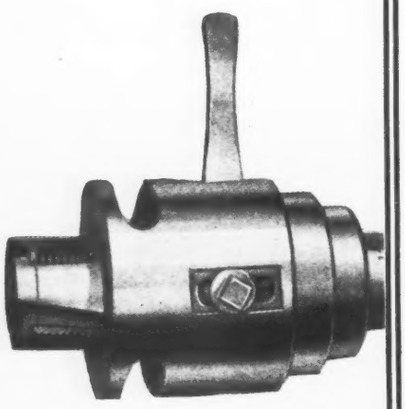
THE DILL SLOTTER PEOPLE

Philadelphia, Pa.

DOMESTIC AGENTS: Henry Prentiss & Co., New York City, Buffalo, Rochester, Syracuse, N. Y.; Boston, Mass.; Hartford, Conn. Motch & Merryweather Machinery Co., Cleveland, Detroit and Cincinnati. Marshall & Huschart Machinery Co., Chicago and Indianapolis. Brown & Zortman Machinery Co., Pittsburgh, Pa. W. E. Shipley Machinery Co., Philadelphia, Pa. Elliott & Stephens Machinery Co., St. Louis, Mo.

FOREIGN AGENTS: Alfred Herbert, Ltd., British Isles. Alfred Herbert, Ltd., Yokohama, Japan. Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium. Societe Anonyme Alfred Herbert, Ltd., Paris, France. Societa Anonima Italiana, Alfred Herbert, Ltd., Milan, Italy.

Victor Collapsible Taps



If the threads you cut cause trouble, either in the cutting or in use, consult with us. No obligation. Ask for Catalog No. 10.

"Good Results"—Good Reason Why

For more than five years Victor Collapsible Taps have been used for tapping brass, iron and steel in the plant of the Ashcroft Manufacturing Company, Bridgeport. At the present time there are about a dozen of these taps in use, ranging from 1⅛″ to 3½″ pipe size.

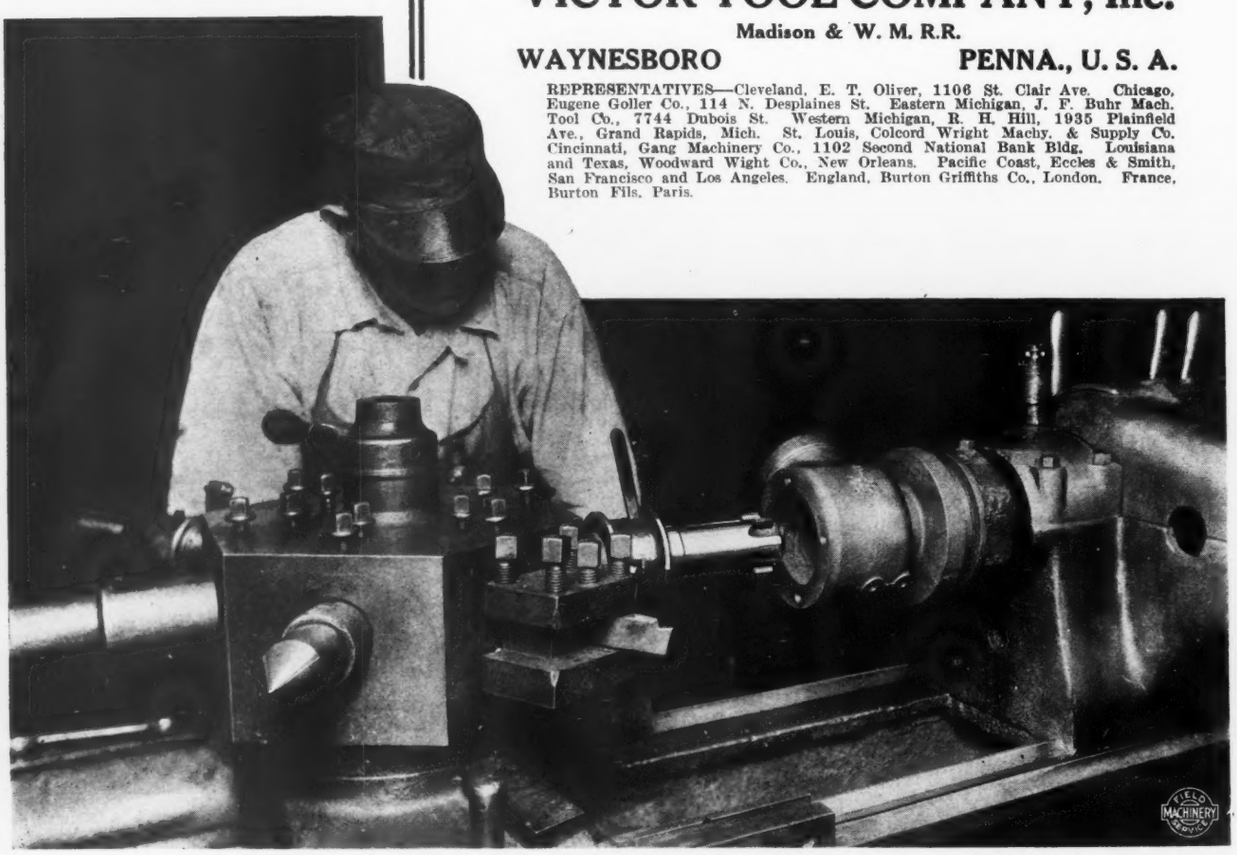
The work consists of valve bodies, which are made in large quantities. A typical job is shown—a valve body made from a mixture of iron and steel, mounted on a turret lathe for a series of operations such as facing, boring and tapping. Threads are checked up by gages and are O. K'd by the inspector. Results are excellent—satisfactory in every way. Costs are "right."

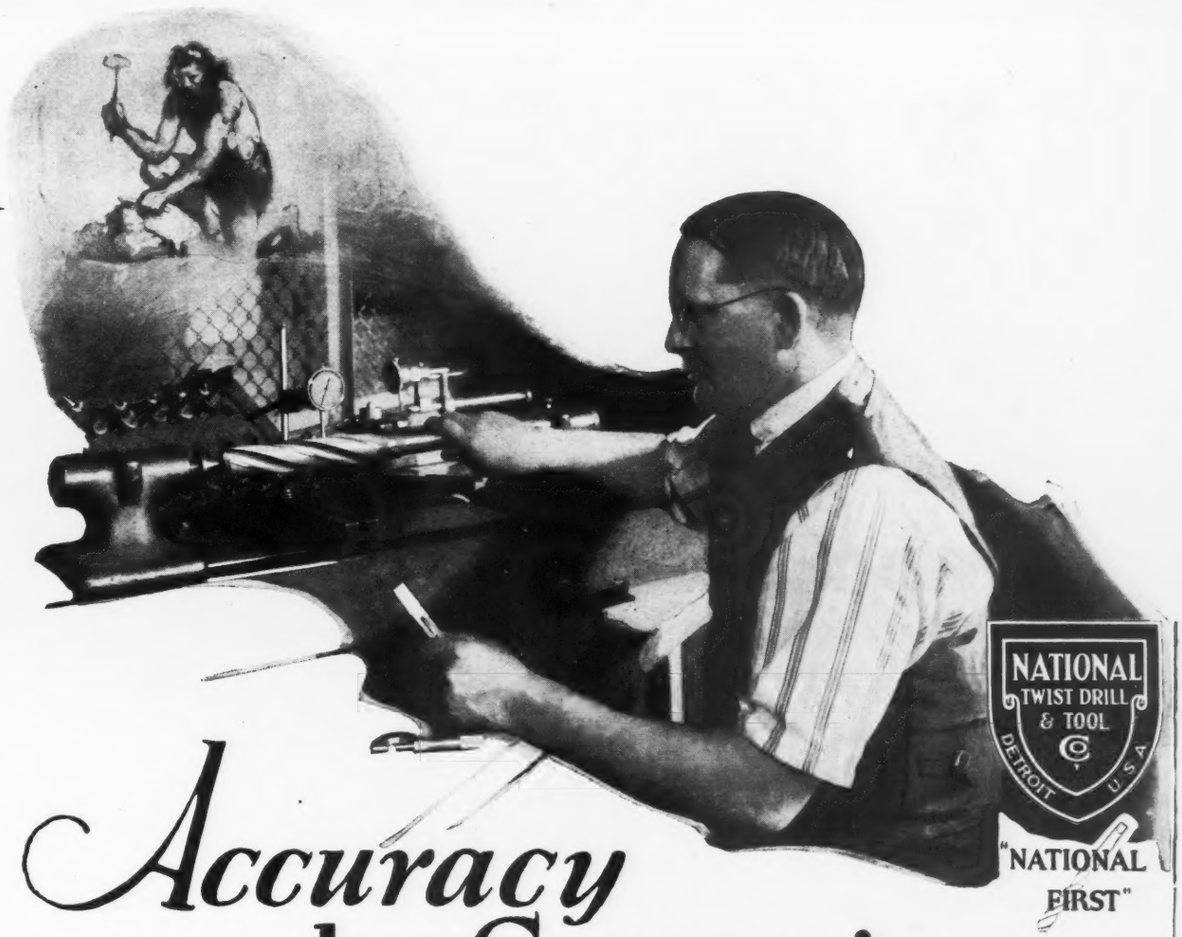
VICTOR TOOL COMPANY, Inc.

Madison & W. M. R.R.

WAYNESBORO PENNA., U. S. A.

REPRESENTATIVES—Cleveland, E. T. Oliver, 1106 St. Clair Ave. Chicago, Eugene Goller Co., 114 N. Desplaines St. Eastern Michigan, J. F. Buhr Mach. Tool Co., 7744 Dubois St. Western Michigan, R. H. Hill, 1935 Plainfield Ave., Grand Rapids, Mich. St. Louis, Colcord Wright Machy. & Supply Co. Cincinnati, Gang Machinery Co., 1102 Second National Bank Bldg. Louisiana and Texas, Woodward Wight Co., New Orleans. Pacific Coast, Eccles & Smith, San Francisco and Los Angeles. England, Burton Griffiths Co., London. France, Burton Fils, Paris.





Accuracy by Comparison

When our ancestors first fashioned their tools and implements from stones the standard of accuracy probably ended with the quarter inch.

From that time up to the present day accuracy has been gradually developed, thru comparison with existing standards, until we now are wont to measure tools not only in thousandths but in ten-thousandths of an inch.

To keep a step ahead of existing demands, and to be the pacemakers in this process of evolution of accuracy, that is the avowed aim of the National Twist Drill & Tool Company.

Whether it be a Twist Drill, Reamer, Milling Cutter or any of the Various Special Tools manufactured by us, we confidently invite your comparison of accuracy with other tools you are buying.

"NATIONAL FIRST"

MANUFACTURERS *of* PARABOLIC MILLING CUTTERS

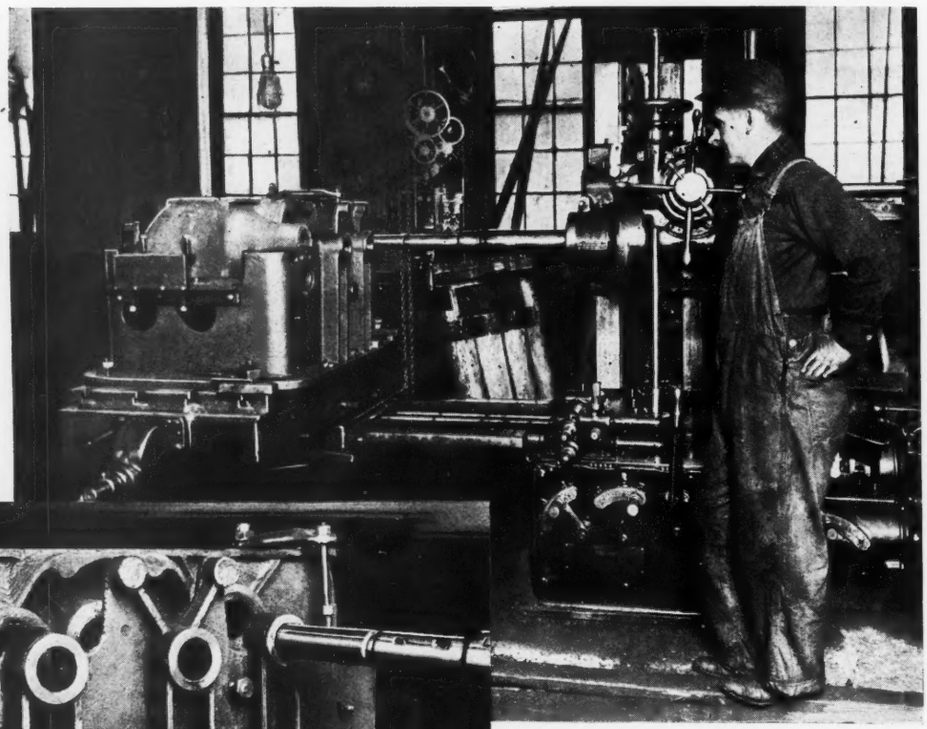
TWIST DRILLS · REAMERS · MILLING CUTTERS · SPECIAL TOOLS

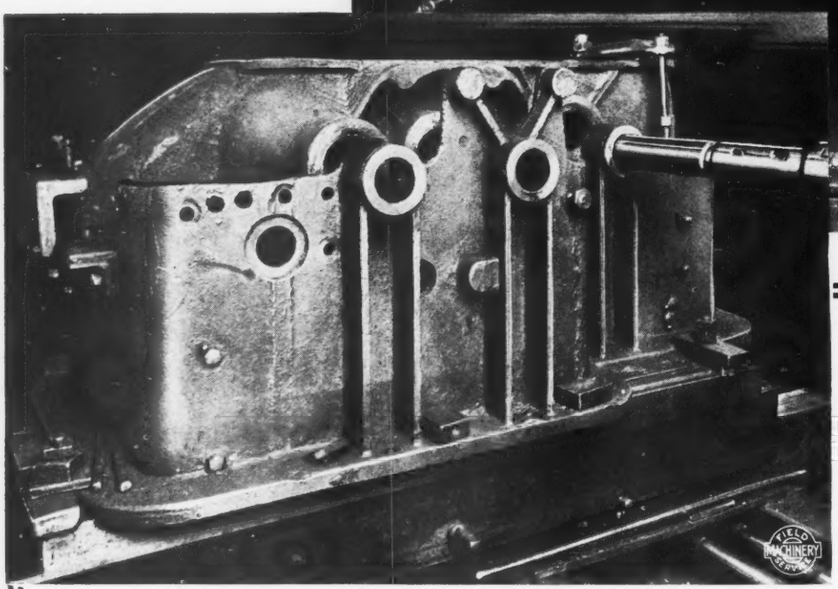
NATIONAL TWIST DRILL & TOOL COMPANY

DETROIT, U·S·A

BRANCHES

NEW YORK, N. Y. 73 Warren Street
PHILADELPHIA, PA. 43 North Sixth Street
CHICAGO, ILL. 565 Washington Blvd
SYRACUSE, N. Y. 107 Gifford Street
BUFFALO, N. Y. 76 Pearl Street





Photos and data obtained by courtesy of the Gray Tractor Company, Minneapolis, Minn.

Boring Transmission Cases for Gray Tractors

Operations performed by the G & L Horizontal Boring Machine shown on cases for Model B 18-36 Tractors include:

1st, bore 4.750 diameter through two bosses, 6½" diameter, 1 3/64" thick, 3 5/16" apart—facing both inside and out. Holes are cored to within ⅜" of finish size and 3/16" to ¼" of stock is removed from the faces.

2nd, bore 3.375" diameter through two bosses, 4⅞" diameter, 2 31/64" thick, 7 11/16" apart, cored to 2⅞", and face both sides of each.

3rd, bore 3.375" through boss 4⅞" diameter, 2 31/64" thick, cored to 2⅞"; and 3.625" through an opposite boss 5" diameter, 1 15/16" thick, cored to 3⅛" diameter and face both sides of each.

4th, drill hole ¾" diameter and counterbore 15/16" to a depth of ⅝".

Output on these cases, including all handling and machining, is 4 per 10 hour day. Accuracy and convenience are outstanding features of G & L machines. Let us tell you more about them.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

FOND DU LAC *Designers and Builders of Special Boring Fixtures* **WISCONSIN**

Henry Prentiss & Company, Rochester, New York City, Syracuse, Boston, Buffalo, Hartford. Motch & Merryweather Machinery Company, Pittsburgh, Cleveland, Detroit, Erie. E. A. Kinsey Company, Cincinnati, Columbus, Indianapolis, Hamilton. Marshall & Huschart Machy. Company, Chicago, Milwaukee. Harron, Rickard & McCone, Los Angeles, San Francisco. Hallidie Machinery Co., Seattle. Southern Machinery Sales Company, Houston. Northern Machinery Co., Minneapolis. Smith-Courtney Co., Richmond. Salt Lake Hardware Co., Salt Lake City. Seeger Machine Tool Co., Atlanta. C. T. Patterson Company, New Orleans. Zimmerman-Wells-Brown Co., Portland. Swind Machinery Co., Philadelphia.

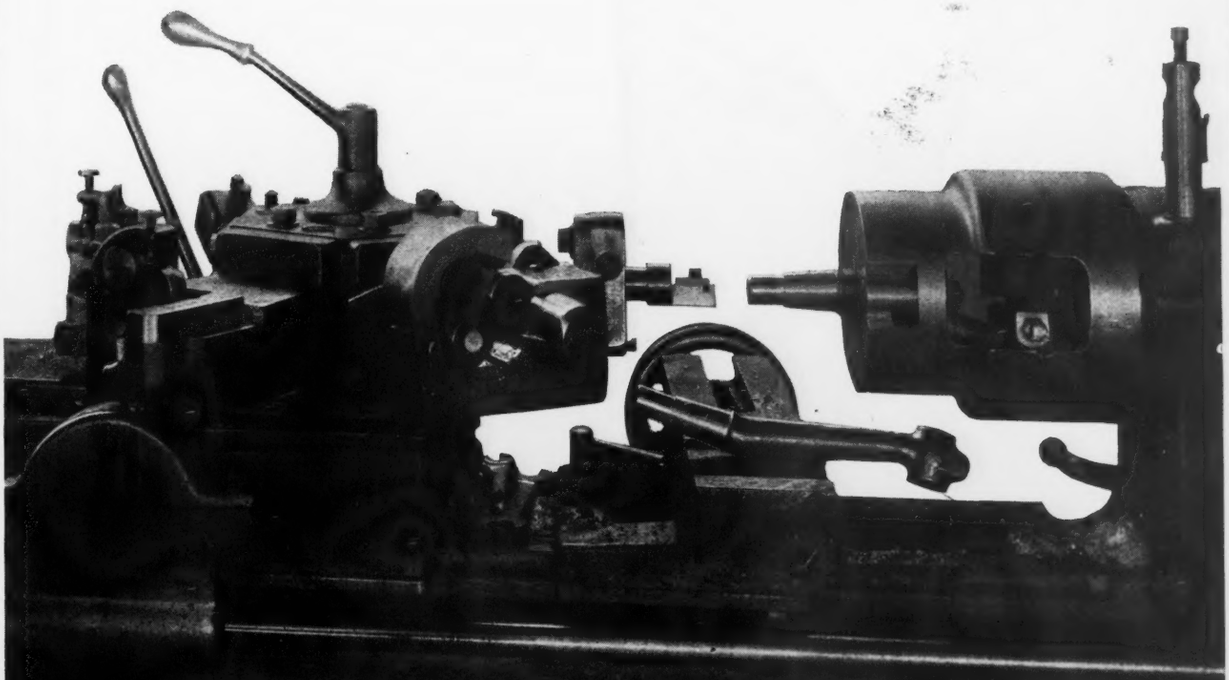
A Prominent Equipment Engineer

A prominent equipment engineer bought W & S Turret Lathes and Tools and paid more for them than was asked for competitive equipment he had investigated.

The Warner & Swasey Engineer, knowing of this investigation, asked if he would explain why his decision had been for W & S equipment.

And this is what he said:

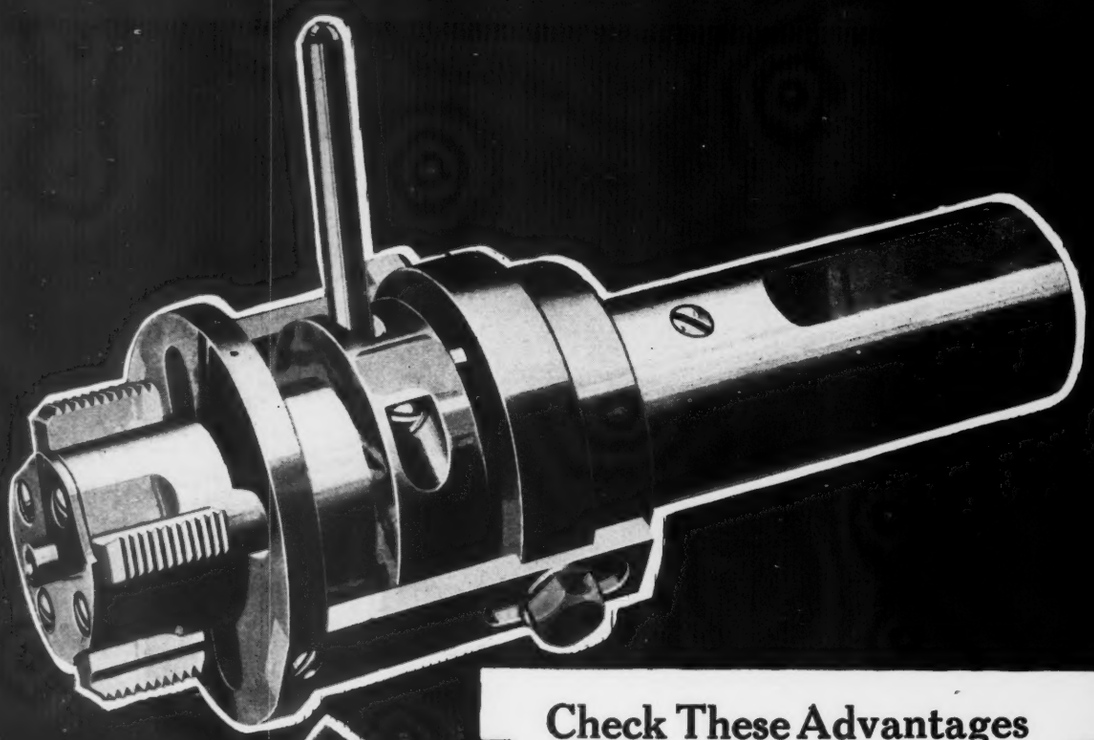
"I have bought a good many turret lathes in my time, of several different makes, but when I buy W & S, I know it will come well tooled, begin producing immediately and keep right on producing, and I can forget it. I am willing to pay quite a premium for whatever it is in your machine that gives me that kind of assurance."

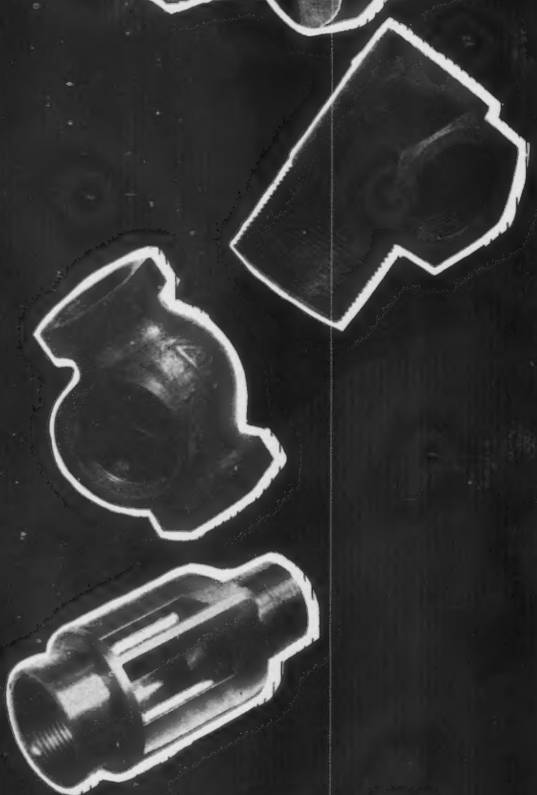


The Warner & Swasey Company

Cleveland, U. S. A.

NEW YORK: Singer Building
CHICAGO: 618-622 Washington Boulevard
MILWAUKEE: 1143 Wells Building
BOSTON: Oliver Building
BUFFALO: Iroquois Building
DETROIT: 5928 Second Boulevard
DAYTON: 518 Mutual Home Building





Check These Advantages Against Your Experience

NAMCO positive Collapsing Taps have

—Chasers with rigid support—they bear full length on tool steel core—do not tilt, wabble or wear in slots.

—Collapsing action as simple as throwing a gear out of mesh, and just as positive.

—One piece core and shank, only three internal parts—rigid, compact and fewer parts than you will find in any other automatic tap.

Aren't these some of the factors that your experience says would help reduce your tapping costs?

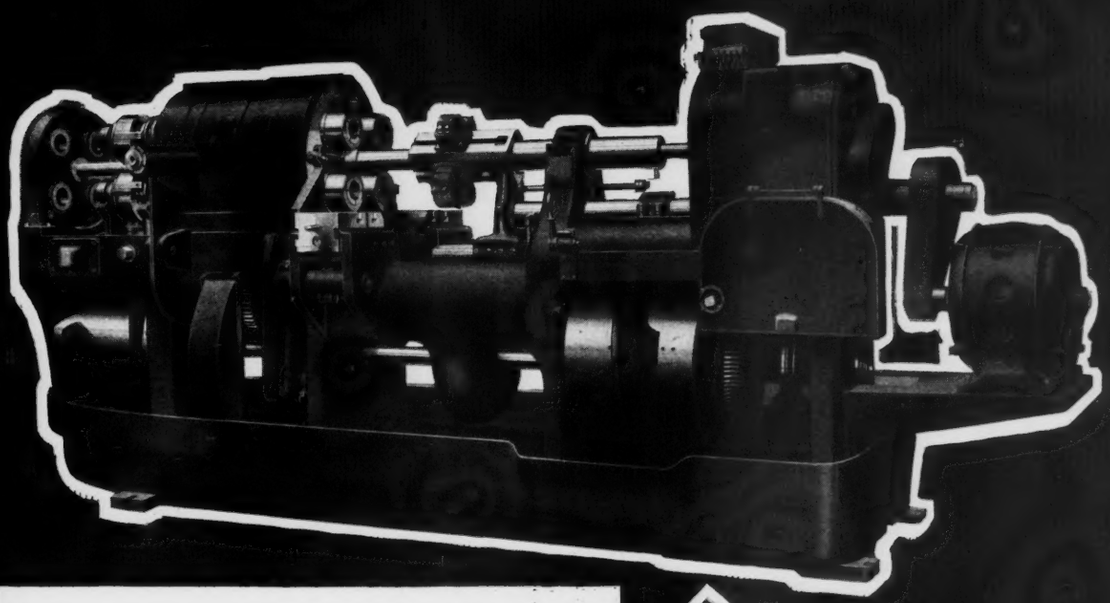
A full line of standard Outside Trip Taps for prompt delivery from stock. Capacities 1″ and up. Also prompt service on special pilot or shank equipment for your special work.

Our T-D Catalog explains the details. Ask for it.

The National Acme Co.

Cleveland, Ohio

NEW YORK
CHICAGO
DETROIT
BUFFALO
BOSTON



Acme 4 Spindle Model "B" A Good Automatic Made Better

A good product, no matter how good, must be constantly improved, or it becomes a back number. Machines which met requirements for speed, finish and cost a few years ago, have kept in the foreground of today's rigid requirements only by constant engineering vigilance for faster speed, strain-resisting construction, simplicity, yet broader tooling adaptability for each machine tool investment.

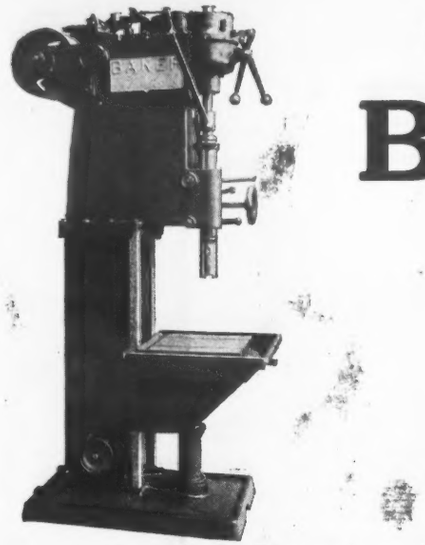
Such is the development of the 2", 3" and 4" Model "B" Acme Automatics. Every detail of materials, design, operating convenience and tool design represents the vigilance of our engineers, backed up by our policy to make a good machine better. Today we believe that Acme Automatics are truly the "Acme" of screw machine efficiency in terms of greater output per hour and lower cost per piece.



The National Acme Co.

Cleveland, Ohio

NEW YORK
CHICAGO
DETROIT
BUFFALO
BOSTON

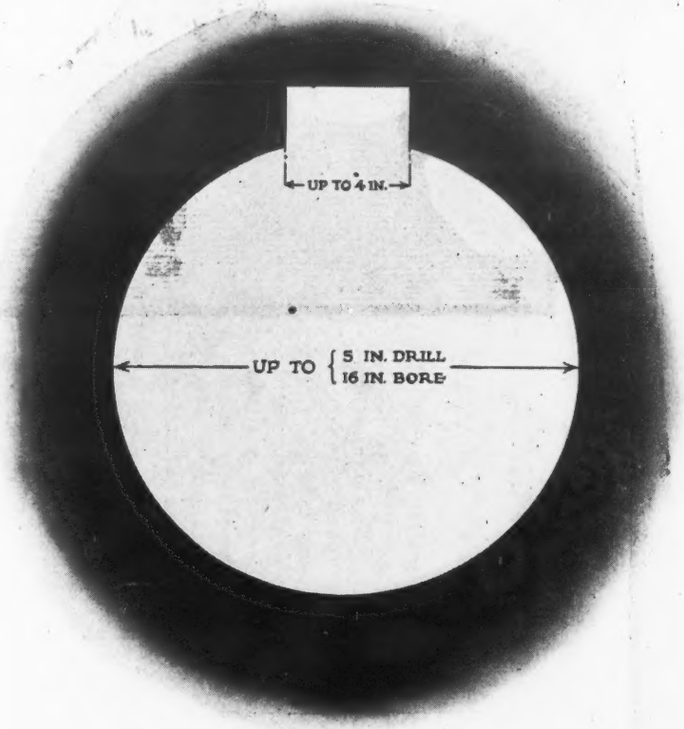


Baker Drills are simple, efficient, easy to operate, and require small floor space. Built in single purpose or quick change types.

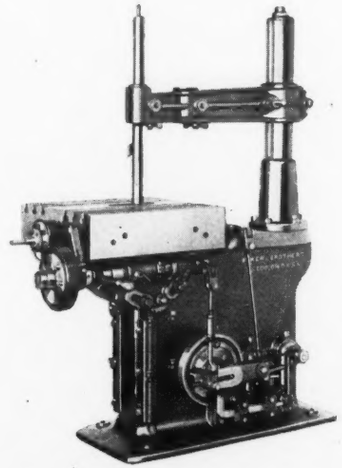
Continued Satisfaction and Economy with

BAKER EQUIPMENT

for DRILLING, BORING and KEYSEATING Operations



Baker Keyseaters are made in five sizes. They are rugged, and insure accuracy with heavy cuts, because of their general construction and upper support for the cutter bar.



Pioneers in the development of Drilling, Boring and Keyseating Equipment, Baker Brothers have fostered this development to the point where they now offer a comprehensive line of machines which covers a very wide field.

Write for complete information.

BAKER BROTHERS, Toledo, Ohio, U.S.A.

SPRINGFIELD



Three "Springfields" Specially Equipped for Drilling Axle Sleeves for White Trucks

Practice at the White Motor Company, Cleveland, is to rough turn these 40 to 50 point carbon steel alloy forgings before sending them to the "Springfield Battery."

Here they are chucked with the heavy end projecting and machined as follows: 1st, drill hole 4¼″ diameter, 7″ deep—work revolving 72 R.P.M. and tool feeding ½″ per minute; 2nd, square up bottom of hole, leaving only the imprint of the drill point to guide the long drill 2½″ diameter, which is next inserted and 3rd, eats its way through the remaining 24″ of solid steel with a feed of 11/16″ per minute, while the work revolves at 96 R.P.M.

Springfield Lathes and Attachments are all interchangeable and can be assembled in whatever combination is best adapted to the operation to be performed. Catalog describes the whole line.

THE SPRINGFIELD MACHINE TOOL COMPANY

Manufacturers of Springfield Lathes and Shapers

631 Southern Ave. **SPRINGFIELD, OHIO**

AGENTS: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Buffalo, Syracuse, New Haven, Pittsburgh, St. Louis, San Francisco, Seattle, Cincinnati. The E. L. Essley Machinery Co., Chicago, Ill. The Riverside Machinery Depot, Detroit, Mich. The Cleveland Duplex Machinery Co., Cleveland, O.

COLONIAL TOOL STEELS



Keeping It Clean

IN the Inspecting Department in the Colonial Mill it is the business, the sole business, of every man to prevent broken tools in your shop. They are the men behind the mill behind your Tool Steels.

Each bar of Colonial Tool Steel has cut from the end a piece long enough to readily reveal any interior flaws. Surface defects, such as slivers, or seams, are of course removed by filing or grinding machines.

This inspection is so rigid, that of the many tons shipped over a long period of years, **less than ½ per cent** has met with objection from **any** cause.

This same clean record of Tool Steel performance is what you may expect regularly in your shop when you standardize on the Colonial brands.

LIST OF TOOLS
and Grades of Colonial Steel
adapted for their use

Name of Tool	Grades of Steel	Name of Tool	Grades of Steel
Arbors	Red Star	Jaw Chuck	Anchor
Augers, Wood & Bits	Red Star	Jaw Vise	Anchor
Axe	Red Star		
		Keys for Drop Hammers	Red Star
Ball Bearings	Superior	Knives, Pocket	Red Star Sheets
Bits, Channeling Machine	Red Star	Knives, Carver	Red Star Sheets
Bits, Coal Mining	Anchor	Knives, Butcher	Red Star Sheets
Bits, Tong	Red Star	Knives, Cleavers	Red Star Sheets
Bits, Well Stone Drilling	Standard Well Bit	Knives, Back Spring	Alto Sheets
Bush Hammer, Stone Tools	Red Star Sheets	Knives, Heel Forming Shoe	No. 14
Bunter, Heading	Red Star	Knives, Shoe Makers	Red Star Sheets
Broaches, Machine	No. 7, High Speed	Knives, Shoe Sole	Red Star
Bushings	Red Star	Knives, Surgical	No. 14
		Knives, Table	Alto Sheets
Center Punches	Red Star	Knives, Potato	Alto Sheets
Center, Lathe (see L)	Red Star	Knives, Corn Knife	Alto Sheets
Chasers, Threading	H. S., No. 7, No. 14	Knives, Drawing	No. 14, Red Star
Chain, Pipe, Links	Vanadium, Type A	Knives, Hog	No. 14
Chisels, Pneumatic	No. 7	Knives, Machine	H. S., Red Star
Chisels, Hand	Red Star	Knives, Paper	H. S., or No. 14
Chisels, Stone Cutters	Red Star	Knives, Shear	No. 7, Red Star
Chisels, Wood Working	Red Star	Knives, Wood Working	H. S., Red Star
Cupping Tools	Red Star	Knurling Tools	No. 7, No. 14
Caulking Tools	Red Star		
Claw Bars	Red Star	Lathe Centers, Dead	Red Star
Creasers, Hoe	H. S., No. 7 E	Lathe Center, Live	Red Star
Counterbores	H. S., No. 14	Lathe Tools for Metal Turning	High Speed
Counterbores, Solid, Interchangeable	H. S., No. 7, No. 14	Lathe Tools for Woodworking	High Speed
Collets, Bit Brace	Red Star	Liners for Brick Dies	Imperial
Collets, Spring	Red Star	Letter Stamps, Hand	No. 7, No. 14
		Letter Stamps, Roll	No. 7, No. 14
Cutters, Fine Finishing	No. 5		
Cutter, Pipe	H. S., No. 14	Mandrels	Red Star
Cutters, Flue	No. 7, High Speed	Mills, End	High Speed
Cutters, Flue Hole	No. 7	Mills, Hollow	High Speed
Cutters, Nail	High Speed	Mills, Shell End	High Speed
Cutters, Corn Stalk	Alto Sheets	Piercers, Hot	High Speed
Cutters, File	High Speed	Pink Steel	Alto
Cutters, Milling, Plain	High Speed	Pinion Bars	Red Star
Cutters, Form	High Speed	Pins, Drift	Red Star
Cutters, Inserted Blade	High Speed	Pitch Bars	Red Star
Cutters, Profile	High Speed	Planer for Metal Tools	High Speed
Cutters, Metal Slitting	High Speed	Planer for Stone	High Speed
Cutters, Screw Slotting	No. 7	Planer for Wood	Red Star
Cutters, Wood Forming	High Speed, No. 5	Point Steel for Stone Cutters	Red Star
Cutting off Tools	High Speed	Punches, Cartridge Shell	No. 7
		Punches, Hand—Hot or Cold Work	H. S., or No. 7
Dies, Bolt Threading	H. S., No. 7, No. 14	Punches, Drawing	No. 7, No. 14
Dies, Blanking	H. S., No. 7, No. 14	Plug Gauges	No. 6, Oil Hard'ng
Dies, Forming & Bending	No. 7, No. 14	Pneumatic Tools	No. 7E or F
Dies, Sub-Press	No. 7, No. 14		
Dies, Drawing	H. S., No. 7, No. 14	Reins, Tong	Red Star
Dies, Cartridge Shell	High Speed, No. 7	Rods, Piston	Red Star
Dies, Hammer Dies, Power	Red Star	Reamers, Hand, Solid	H. S., or No. 5
Dies, Flat Jack Jewelers' Dies	High Speed No. 7	Reamers, Shell	High Speed
Dies, Drop Forging	Red Star, Alto	Reamers, Taper	High Speed
Dies, Nail	High Speed	Reamers, Rose, Chucking	High Speed
Dies, for Paper	H. S., No. 14	Reamers, Locomotive, Taper	No. 14, H. S.
Dies, Pipe Threading	H. S., No. 7, No. 14	Reamers, Bridge	High Speed
Dies, Solid & Adjustable Threading	H. S., No. 7, No. 14	Reamers, Expansion, Hand	High Speed
Dies, Glove	No. 7, No. 14	Reamers, Drill & Countersink	No. 5
Dies, Rivet	No. 7, Red Star	Rolls, Flue Expanding	No. 7
Dies, Shoe Knife	Red Star	Ring Gauges	No. 6, Oil Hard'ng
Dies, Spring Screw, Threading	H. S., No. 7, No. 14	Rivet Sets	No. 7, Red Star
Dies, Solid Bolt	No. 7, No. 14		
Dies, Adjustable, Round		Shear Blades—Hot Work	H. S., No. 7
Dies, Split Threading	H. S., No. 7, No. 14	Shear Blades—Cold Work	No. 7, Red Star
Dies, Spoon, Silver	No. 14	Saws, Circular Metal	H. S., Nikro
Dies, Silversmith	No. 7	Saws, Circular Wood	Nikro
Dies, Domino Screw Cold Heading	No. 7, Red Star	Scrapers for Scraping Machine Parts	No. 5
Dies, Cold Heading	No. 7, Red Star	Scrapers, Tube	Red Star
Dies, Hot Heading	H. S. or No. 35	Screw Drivers	Red Star
Dies, Wire Drawing	No. 14		
Dies, Plates	No. 7, No. 14	Set—Rivet	No. 7, Red Star
Digging Bars	Red Star	Sets—Button	No. 7, Red Star
Drills for Boring	Red Star	Sets—Nail	Red Star
Drills, Tool Steel	H. S., Superior	Splitting Tool	High Speed
Drills for Stone	Red Star	Shaper Tool	High Speed
		Stamping Tools	No. 7, No. 14
Drills, Twist	High Speed	Sledges, Blacksmith & Stone	Red Star
Drills, Flat	High Speed	Snaps, Rivet	No. 7, Red Star
Engraver Tools	No. 14	Springs	Red Star
		Swages, Blacksmith	Red Star
Furnace Bars	Anchor	Swaging Metal	No. 7
Flatters, Blacksmiths	Red Star	Taps, Tapper	No. 14, Red Star
Fullers, Blacksmiths	Red Star	Taps, Hand	Red Star Tap, Extra No. 14
Forming Tools for Metals	H. S., No. 5, No. 14		
Flange Tire Forming Tools	High Speed	Taps, Machine	H. S., Red Star
Gear Cutters	High Speed	Taps, Automatic Machine Screw	High Speed, No. 3
Gauges	Oil Hardening No. 6		
Grip Dies for Rivets, Hot	No. 35	Taps, Strayhole	No. 14
		Taps, Pipe Taps	Red Star
Hatchets	Red Star	Taps, Pipe Tap Chasers	High Speed, No. 3
Hammers, Blacksmiths	Red Star	Tire Turning	High Speed
Hammers for Crushing Machines	Red Star	Tool Holder Bits	High Speed
Hammers, Pneumatic	No. 7		
Hammers, Nail Machines	No. 7	Wedge, Stone	Red Star
Hammers, Riveting Pneumatic	No. 7	Wedges	Red Star
Hubs, Gear	H. S., No. 7, No. 14	Wrenches, Track	Red Star
Header Dies, Cold	No. 7, Red Star		
Header Dies, Hot	No. 36		

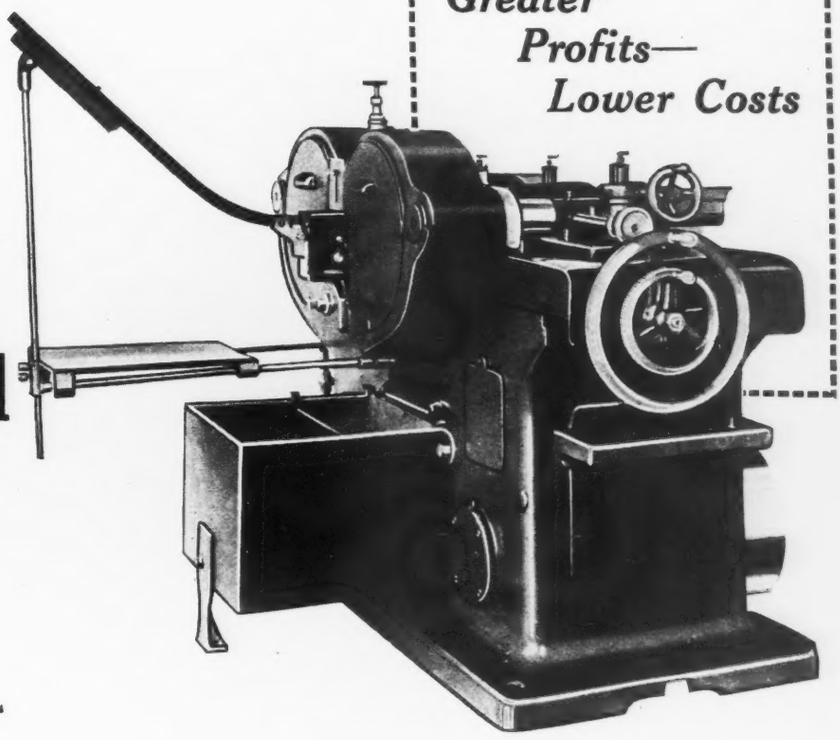
Full instructions for hardening and tempering all Colonial Tool Steels will be found in the *Colonial Heat Treating Book*.
MAILED FREE.

Colonial Steel Company

PITTSBURGH BOSTON NEW HAVEN NEW YORK CLEVELAND
CINCINNATI DETROIT CHICAGO ST. LOUIS

The Heim Centerless Cylindrical Grinder

Greater Profits— Lower Costs



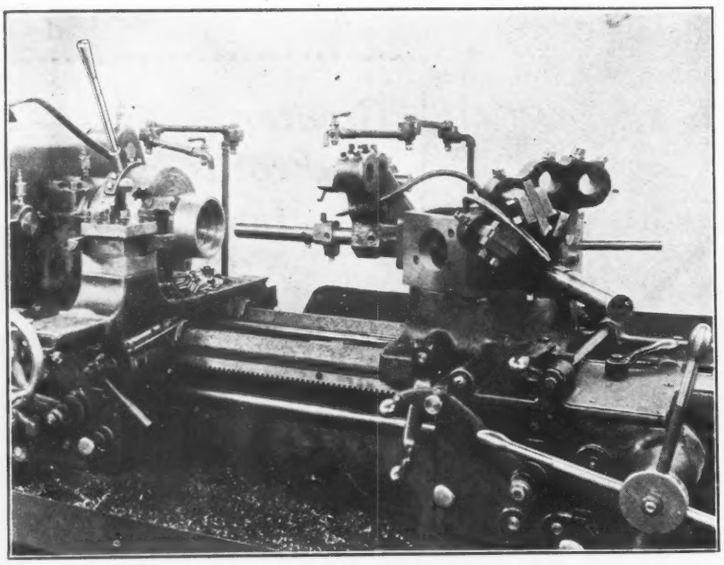
It all depends on your work. If your products are in the class served by this machine the increase in profits will be tremendous. We have records of production increases higher than six times the best figure obtainable by other grinding methods. We have records of successful application on work that is usually considered beyond the range of the centerless grinder.

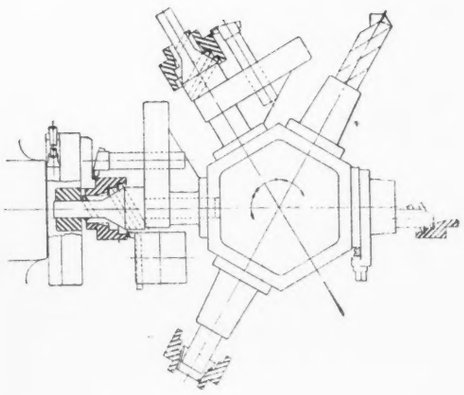
So, if you do straight, taper or shoulder grinding on any class of work we can show you how to greatly increase your profits.

Tell us about your cylindrical grinding problems. Send us samples of work to be ground—we'll give you production and cost estimates that will astonish you.

The Ball & Roller Bearing Company

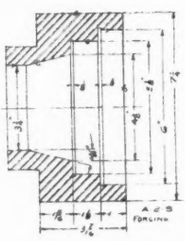
DANBURY, CONN., U. S. A.





Steel gear forgings machined internal and external in 24 minutes on the

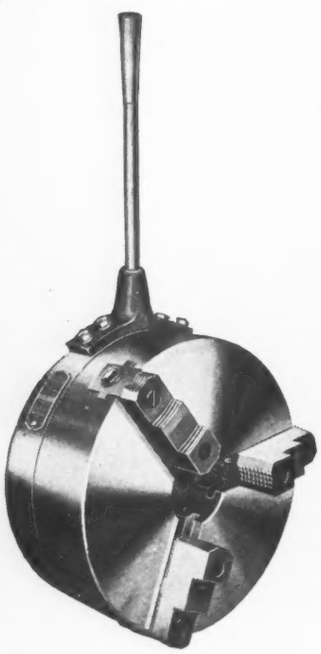
FOSTER 3-B Universal Turret Lathe equipped with an 18" Foster-Barker Chuck



The Machined Forging

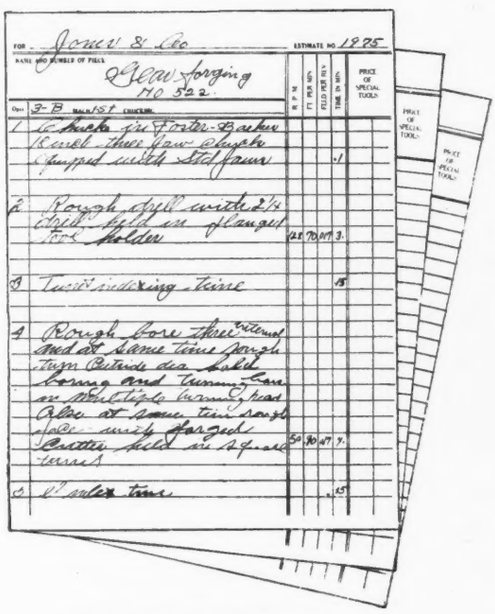
Here's another job on the Foster giving tangible evidence of its power, its rigidity and accuracy.

Taking four heavy hogging cuts and standing up under this continuous heavy duty is an ample demonstration of its stability and quality.



The developments of the machines of the Foster line have kept pace with the developments of modern high speed tool steels and they will meet to the fullest extent all industrial requirements coming within their range.

Our machinery catalog describes all machines of the Foster line; also the Foster-Barker wrenchless chuck.



Foster Production Estimates

FOSTER Methods are

methods of accuracy and speed. Our estimates on your work will give you definite and accurate information covering Foster advantages.

Send us your blueprints.

FOSTER MACHINE CO., Elkhart, Ind.

CHICAGO OFFICE: 549 W. WASHINGTON BLVD.
NEW YORK OFFICE: 30 CHURCH STREET

"SHELBY"

"SHELBY" SEAMLESS STEEL TUBING is regularly furnished in high-grade, uniform steels of suitable alloy for

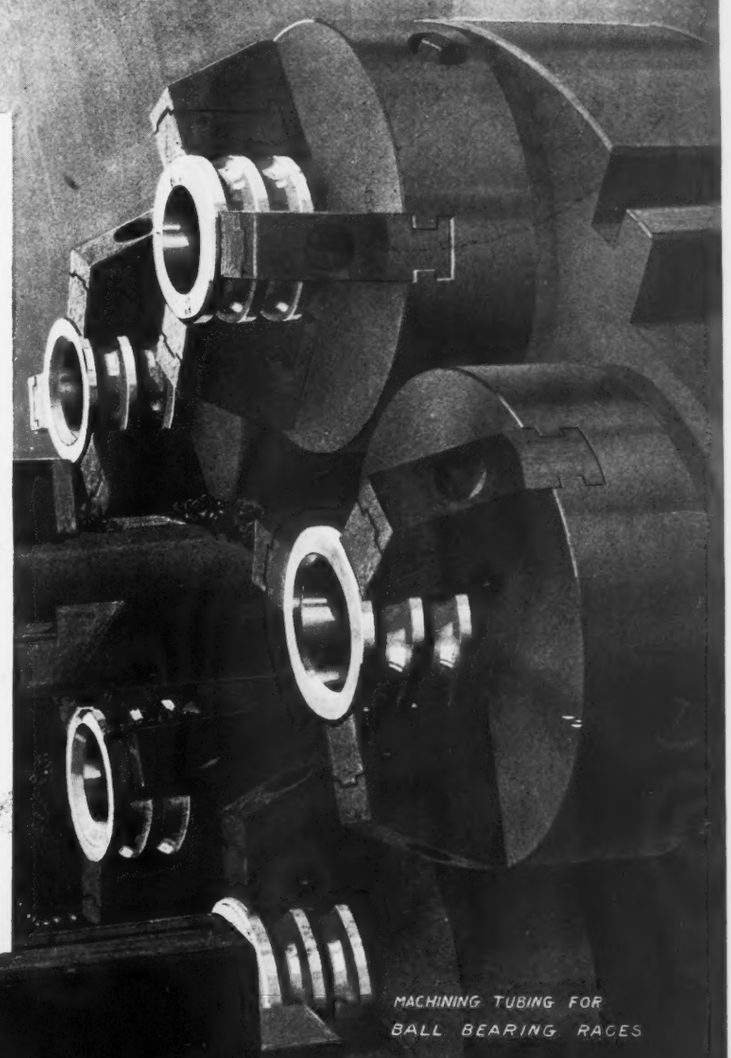
BALL AND ROLLER BEARINGS

The material case-carbonizes or case-hardens uniformly, is highly accurate in diameter and wall-thickness, and machines readily with little waste stock.

When used in place of solid or forged stock, tubular material permits increased and intensive production in the manufacture of ball and roller bearings and many other products.

Ask for Bulletin No. 17—
The Mechanical Uses of "SHELBY" SEAMLESS STEEL TUBING

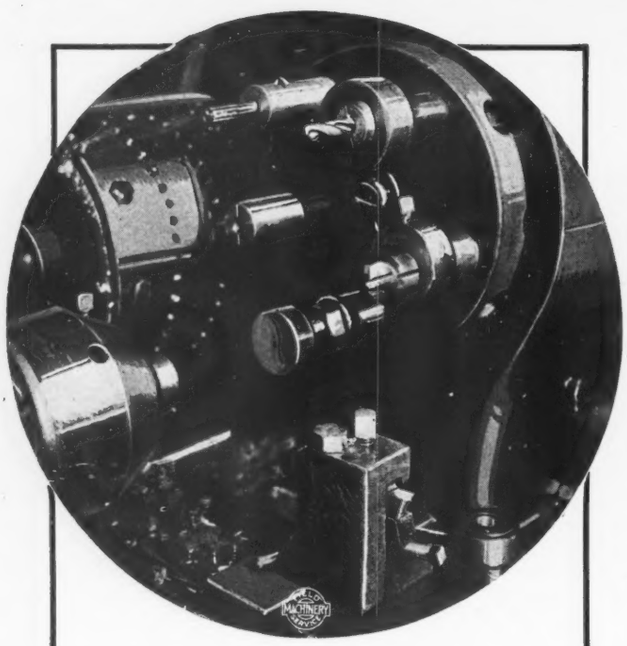
NATIONAL TUBE COMPANY
Frick Building Pittsburgh, Pa.
District Sales Offices in The Larger Cities

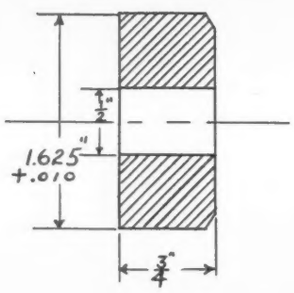


MACHINING TUBING FOR BALL BEARING RACES

THE RECOGNIZED STANDARD OF SEAMLESS STEEL TUBING

CLEVELAND AUTOMATICS





A Typical Installation Getting the Usual Profitable Results

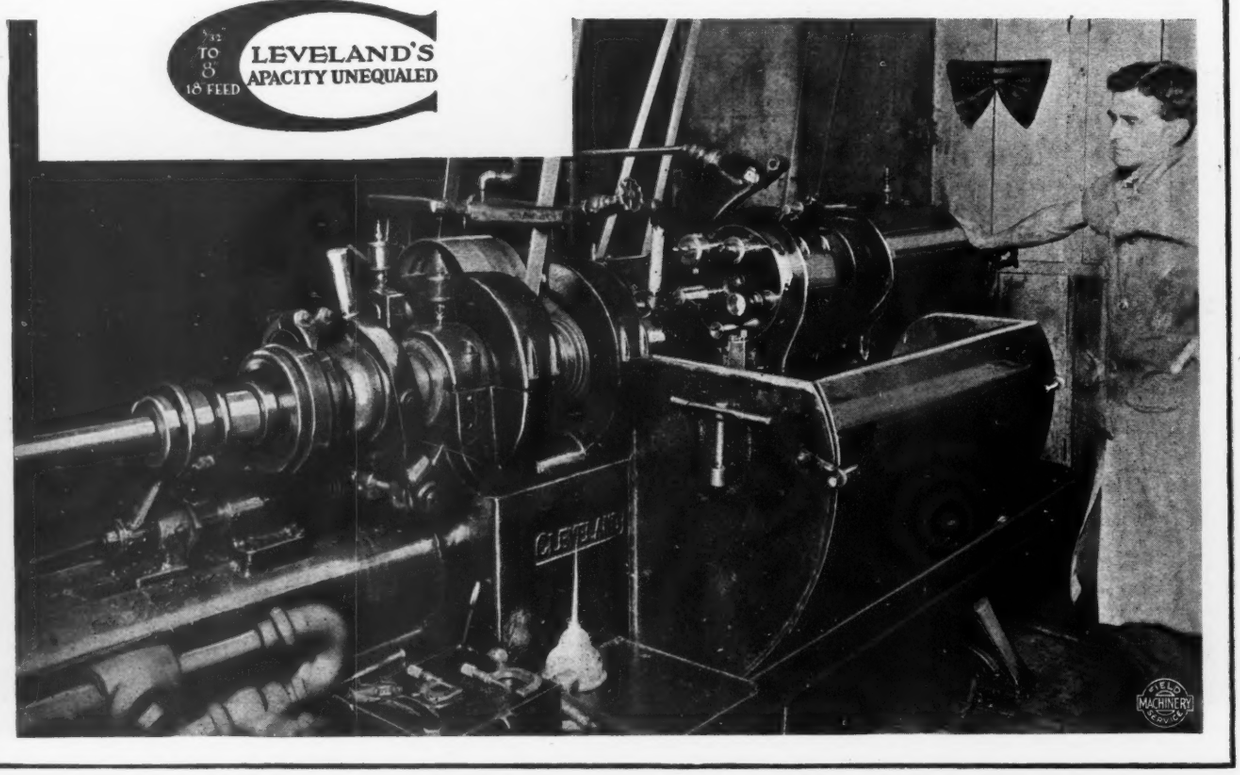
There's nothing unusual about this battery of six Cleveland Automatics at the Standard Motor Construction Company, Jersey City, N. J. Kept busy on all kinds of work in the construction of Standard Marine Engines, they deliver the goods with the usual wide margin of profit that makes them so consistently popular.

The sketch gives the details of a typical series of operations in the manufacture of valve lifter rolls. Four of the five turret holes on this machine are used to produce this part and the operations are as follows: first, feed stock to gauge stop; second, center—the outside diameter and chamfer are formed at the same time by a tool mounted on the front cross slide; third, reamer drill for ½" hole; fourth, ½" ream, after which the cutting tool on the rear cross slide cuts off the roll. Production figures—not available—are declared to be "mighty satisfactory."

We'll be glad to quote production on other operations or give you estimates on work that interests you.

THE CLEVELAND AUTOMATIC MACHINE COMPANY

CLEVELAND OHIO, U. S. A.





JOHN BRIGHT introduces International 84 —the cleaner DE LUXE—at 11¾c. a pound

HERE'S the newest addition to my large family of cleaners. It is the best compound that has ever been perfected—regardless of price—for fine cleaning, especially on highly oxidizable metals, and it can handle a large variety of work. That's why we call it De Luxe.

International 84 is entirely soluble and dry. Works wonders for either still or electric cleaning. It removes buffing composition as well as vegetable, mineral and animal oils. It will not tarnish oxidizable metals nor injure the hands and clothing of workmen.

Three to four ounces of 84 to the gallon of water makes a cracker-jack solution that both emulsifies and saponifies. And say, it's a regular Methuselah when it comes to long life in the cleaning tank.

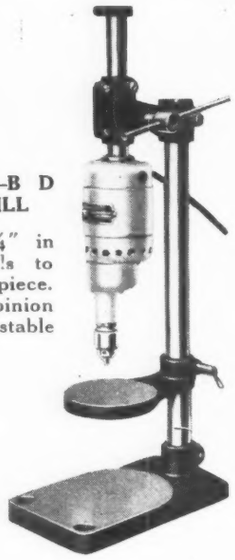
I want you to meet our new cleaner face to face. Although it is comparatively new, hundreds of tests have proved its merits. I'll stand responsible for its performance and behavior, as usual. Trial lot won't cost you a cent unless it meets your fullest expectations.

Internationally yours
John Bright

International Products
I.C.C.
International Chemical Co

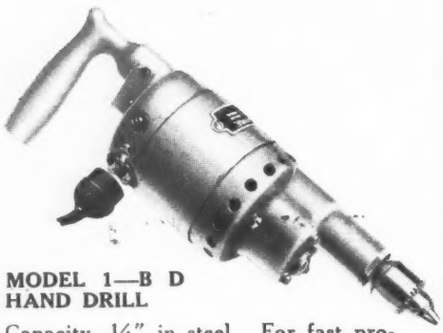
INTERNATIONAL CHEMICAL CO.

PHILADELPHIA ~~~~~ PENNA.



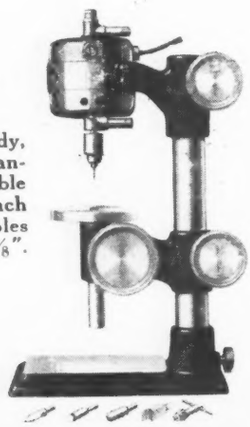
MODEL 2—B D BENCH DRILL

Capacity, ¼" in steel. Drills to center of 8" piece. Rack and pinion feed. Adjustable table.



MODEL 1—B D HAND DRILL

Capacity, ¼" in steel. For fast production drilling in steel, alloys and wood.



PRECISION DRILL

Sensitive, speedy, accurate. A handy, dependable tool for bench work. Drills holes from .004" to ⅛".

For Those Who Like to Do a Good Job Quick

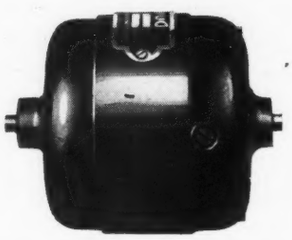
WORKMEN on piecework, factory superintendents, production managers—all find the dependability of Dumore Drills an important factor in their work.

Great savers of time and labor—easy to handle—convenient to operate, these light weight tools can easily be carried about from place to place. They eliminate expensive tear-downs and do away with slow tiresome hand work. Dumore Drills will meet your drilling requirements as satisfactorily as they have met the needs of thousands of others. If you are not already equipped with motor driven drills or if you are contemplating a change from the type you are now using—you will do well to consider the Dumore. They're always ready to work—each a sturdy, efficient, labor-saving tool.

A request from you will bring our Folder, No. 113, showing the many ways in which Dumore Drills can be used and how they will save you money. Your copy is ready—send for it today.

WISCONSIN ELECTRIC CO.

2562 Sixteenth Street RACINE, WISCONSIN



TYPE A MOTOR STRIPPED

A complete line of Dumore F. H. motors, ranging from 1/40 to ¼ h. p. is now available to those who desire small motors for special applications.

DUMORE

GEARED ELECTRIC DRILLS

These Tools Reduce the Cost of Extreme Accuracy

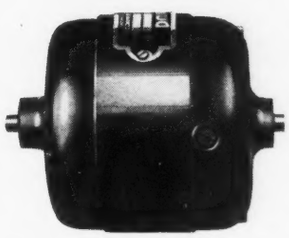
AMERICA'S leading metal working industries, desiring to obtain exacting limits at least possible cost, have equipped their plants with Dumore High Speed Grinders. Experience has shown that these precision tools are almost invaluable because of their ability to economically perform a wide variety of close grinding operations in tool-room and shop. In many instances these handy tools are used exclusively for production work where extreme accuracy is required.

Perfect running balance eliminating vibration; speed ranges of 10,000 to 50,000 r.p.m., assuring absence of taper and bell-mouth—these are but a few of the advantages gained by those who use Dumore Grinders. If you are interested—if you would learn complete details of the many ways in which Dumore Grinders can increase production at lower operating costs, write for Booklet No. 40. Full particulars of actual job records are yours for the asking.

Your name and address, please!

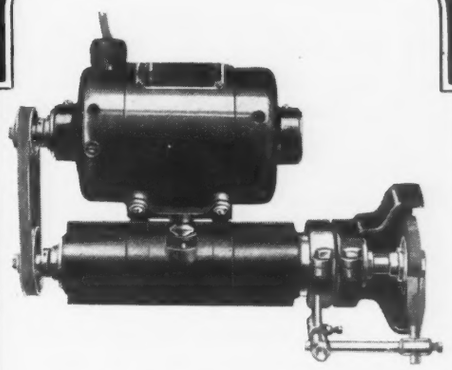
WISCONSIN ELECTRIC CO.

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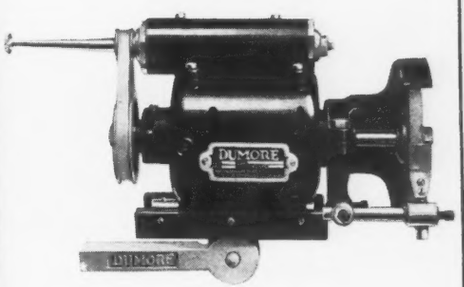
NO. 3—MULTI-SPEED GRINDER

Rated at ¼ h. p. Compact enough to use on any size lathe down to and including 8".



NO. 1—J G GRINDER

Speed 15,000 R.P.M. An ideal tool for repair shop or tool-room.



NO. 2—A G GRINDER

For general tool-room use. Spindle speeds 10,000 and 30,000 R.P.M.

DUMORE

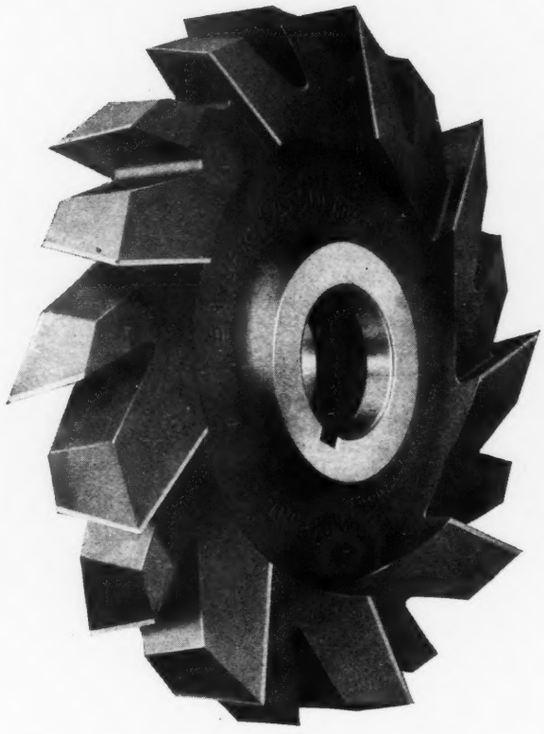
HIGH SPEED GRINDERS

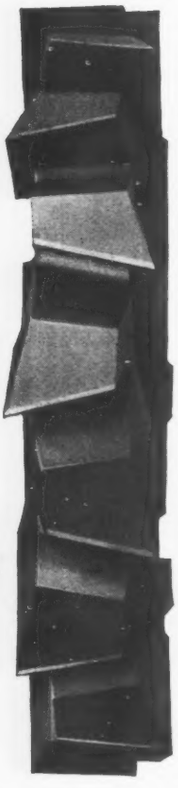
BARBER-COLMAN

HEAVY DUTY

Staggered
Tooth
Alternate
Gashed

MILLING CUTTERS





In designing this series of Cutters we have incorporated almost every known detail of construction to make these cutters the last word in production ability.

For straddle milling and deep slot milling we believe them unbeatable.

Our customers who have used them tell us we have succeeded far beyond their expectations.

Should you have a particularly tough job of deep slotting or straddle milling, order this type. You will be surprised at the feed and speed possible with less power consumed and the smooth finished cut obtained.

Write for our pamphlet more fully describing these cutters.

BARBER-COLMAN COMPANY

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BROOKLANDS NEAR MANCHESTER-ENGLAND.

110

Slocomb Micrometers

Meet Every Test





Reg. U. S. Pat. Office

The name not the frame identifies the "Longest Lived Micrometer that can be bought"

Some folks just have to be shown!

It isn't enough for them that many leading automobile manufacturers, machine builders, contract shops and other discriminating "consumers" use *only* Slocomb Micrometers for gaging and inspecting important dimensions of their products—they must try for themselves—and we're glad to have them try—glad, too, when a skeptical prospect begins testing Slocomb Micrometers with Johansson Blocks. That means a speedy capitulation.

Slocomb Micrometers pass tests for convenience and durability with equal success, though time alone is able to show how fully they have earned their right to be called "the longest lived micrometers that can be bought." All styles and sizes, 0 to 48″ capacity, described in catalog 16.

Slocomb Catalog No. 16 describes our inside line as well as the famous Slocomb Combined Drills and Countersinks.



J. T. SLOCOMB COMPANY, PROVIDENCE, R.I.

Chicago Representative: R. R. Street & Co., 28 North Clinton Street.
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FOREIGN AGENTS: England: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Japan: Alfred Herbert, Ltd., Yokohama. Italy: Chas. Civita, Milan. Australia: Edwin Wood, Pty., Ltd., Melbourne and Sydney. France: Aux Forges de Vulcain, Paris, Lyons, Lille and Bordeaux.

A NEED—

"A reduction in cost of manufacturing and the employment of every inch of floor space in every factory were never so much needed."

E. N. Hurley at National Foreign Trade Council, New Orleans.

A REMEDY—

The Wright Dieing Machine

The Wright Dieing Machine takes the place of the familiar power press, turns out more and better work; saves and protects operators; occupies less floor space and needs no head room. By reason of its compact but powerful construction, tools are kept in perfect alignment, and need less frequent sharpening or renewal.

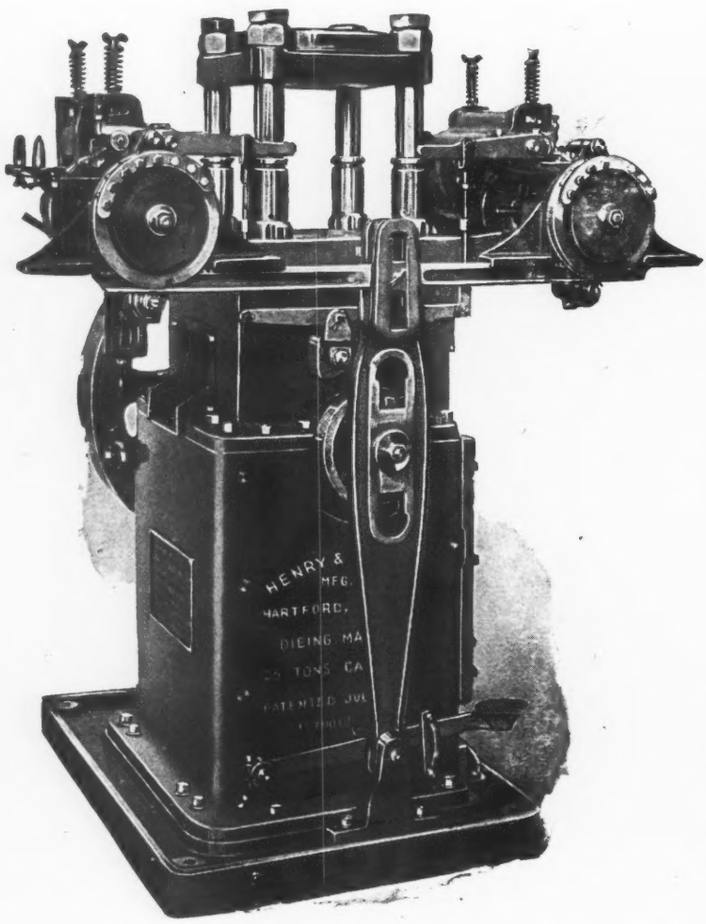
Operation is like a subpress; working parts except punch and die are concealed, but readily accessible from all sides, attachment of special feed, cut or carry fixtures is a simple matter.

Wright Roll Feed reduces the amount of labor and attention ordinarily required by punch presses. One man can keep a number of machines supplied with stock.

Users of Wright Dieing Machines report from fifty to two hundred per cent greater production; longer life of dies; general satisfaction with the equipment.

Let us send the details.

Patented July 2, 1918
Other Patents Pending



10, 25 and 50 Ton Sizes

The Henry & Wright Manufacturing Company

Builders of Dieing and Drilling Machines

760 Windsor Street
HARTFORD, CONN., U.S.A.



New Departure Ball Bearings

Engineers Depend on this Book

IT is considered just as important nowadays to know where to look for information as it is to have the head crammed with facts. We are told that more mechanical engineers use this New Departure volume of Engineering Data Bulletins as a manual and reference work than any other book.

Five thousand technical men keep it in their reference libraries and add to it each month the supplements which keep the book up-to-date and themselves conversant with every advance in engineering practice with reference to bearing design and application.

It contains over 200 pages of solid meat, yet the drawings are so profuse, the text so condensed and subject matter so carefully indexed that the information desired can be located without delay or difficulty. As the usefulness of this work is confined to technical men, we must ask that requests be made on your company letterhead.

THE NEW DEPARTURE MANUFACTURING COMPANY,

Bristol, Conn.

Detroit Chicago

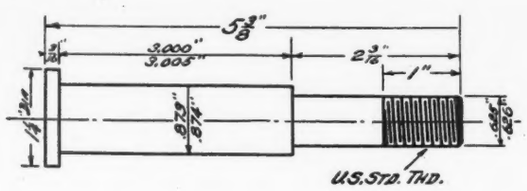
56 Victoria St., London, S. W. 1



They're Using 7½ Year Old Chasers in this

HARTNESS DIE HEAD

The American Type Founders Company, Jersey City, N. J., finds the best way to insure belt tighteners against the inevitable vibration in service is to secure a close fit by using a Hartness Turret Lathe equipped with a Hartness Self-Opening Die Head, for the threading operation. Production averages 3½ minutes a piece, and though as noted above, the chasers have already seen 7½ years of service the threads are held to the same limits as the pins in which they are cut. Doesn't this record make you want to hear more about the Hartness Automatic Die Head?



JONES & LAMSON MACHINE CO., Die Division **Springfield, Vermont**

503 Market St., San Francisco, Cal. 9-10 Water Lane, Queen Victoria St., London, England

Principles of Interchangeable Manufacturing

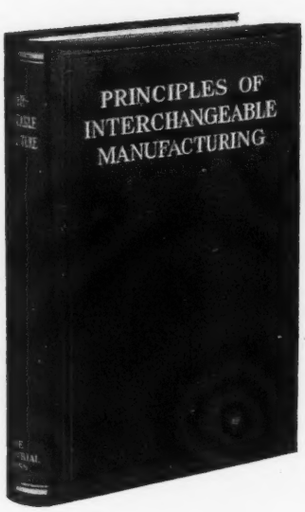
By Major Earle Buckingham, A.S.M.E., S.A.E.

Engineer, Pratt & Whitney Co.

A treatise on the Basic Principles involved in Successful Interchangeable Manufacturing Practice covering Design, Tolerances, Drawings, Manufacturing Equipment, Gaging and Inspection.

This is the first complete treatise on interchangeable manufacturing, as a whole, that has appeared and *it was written by an authority.* The book defines and emphasizes the underlying basic principles, using specific methods to illustrate their application. The information upon which this treatise is based was gathered from many manufacturing plants both large and small in this country and Canada. Every method discussed is in successful operation and for that reason the book is of great value to the industry.

In this book, as well as in every volume of MACHINERY'S Books on Machine Shop and Drafting-Room Practice, you will find a Self-Examination Sheet which enables the reader to get the utmost possible value out of the book. The Self-Examination Sheet makes home study easy and interesting.



254 Pages—6 x 9 inches—Fully Illustrated

FREE INSPECTION COUPON

THE INDUSTRIAL PRESS,
140-148 Lafayette Street, New York City.

You may send me, all delivery charges paid, for five days' examination, your book "Principles of Interchangeable Manufacturing." I will either return it in five days or send you $3.00 within 30 days, paying for it in full.

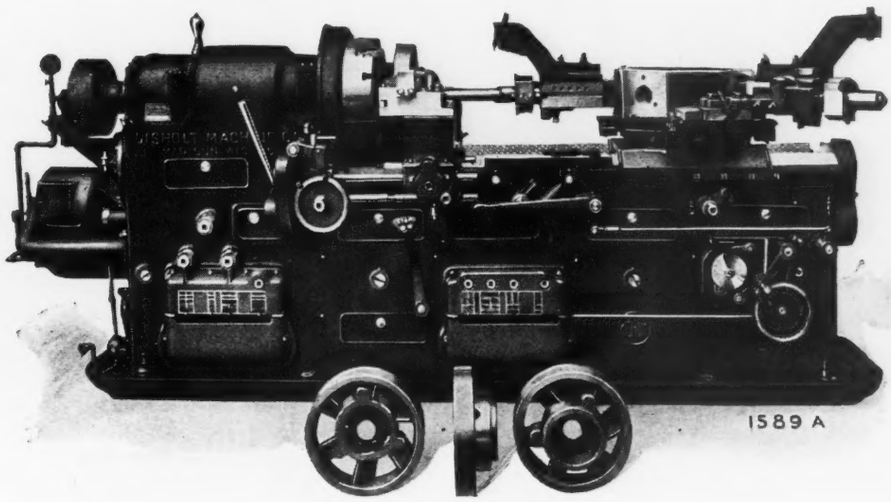
Name .....

Address ..... City and State .....

Position ..... Firm .....

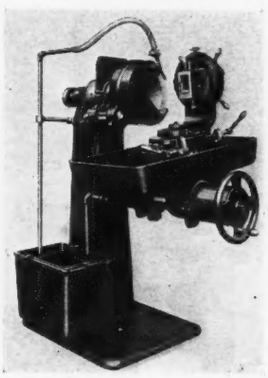
8-23

GISHOLT



20-INCH AUTOMATIC TURRET LATHE

One of two Automatic Turret Lathes, operated by one man, which replaced two hand lathes, operated by two men. Besides saving labor, the automatics increased the production 10 wheels a day, and improved the accuracy of the product.



UNIVERSAL TOOL GRINDER
For sharpening single point cutting tools

In addition to heavy machine tools, we also manufacture small tools, such as Solid Adjustable Reamers, Boring Bars, Tool Holders, and Chucks.

To assist users of Gisholt machines in getting the greatest results from them we conduct an intensified course of training called the Gisholt School.

Don't you think it would be worth while to ask us for more information on any of these subjects—they are universally instrumental in cutting costs.



STANDARD TURRET LATHE
Made in six sizes, 13 inch to 41 inch.

GISHOLT MACHINE COMPANY

9 So. Baldwin Street **MADISON, WISCONSIN**

Eastern Office: **Room 1725, 30 Church St., New York** ***Cleveland Office:*** **1888 Page Avenue, Cleveland, Ohio**

BARNES RADIAL DRILL

Spindle Travel 18 inches
No. 4 taper hole in spindle
Weight 3,300 lbs.
Table 24" x 65"

WE illustrate herewith a No. 3 Horizontal Radial Drill or End Drilling and Tapping Machine. The machine is back-geared, strong and well built, and all parts are within easy reach of the operator. The table is slotted for holding the work; the arm is of heavy box pattern, and the sliding head is gibbed strongly on the square ways of the arm. For operating the spindle, the operator has choice of three feeds; namely, the lever feed or the handwheel feed or power feed. Power feed has positive drive.

Dimensions No. 3 Horizontal Drill:

Distance from top of table to center of bearing, 8¾ inches.

Center of bearing to maximum height of spindle, 38¼ inches.

Bearing, 9 by 12 inches long.

Spindle arm moves through circle of 180 degrees.

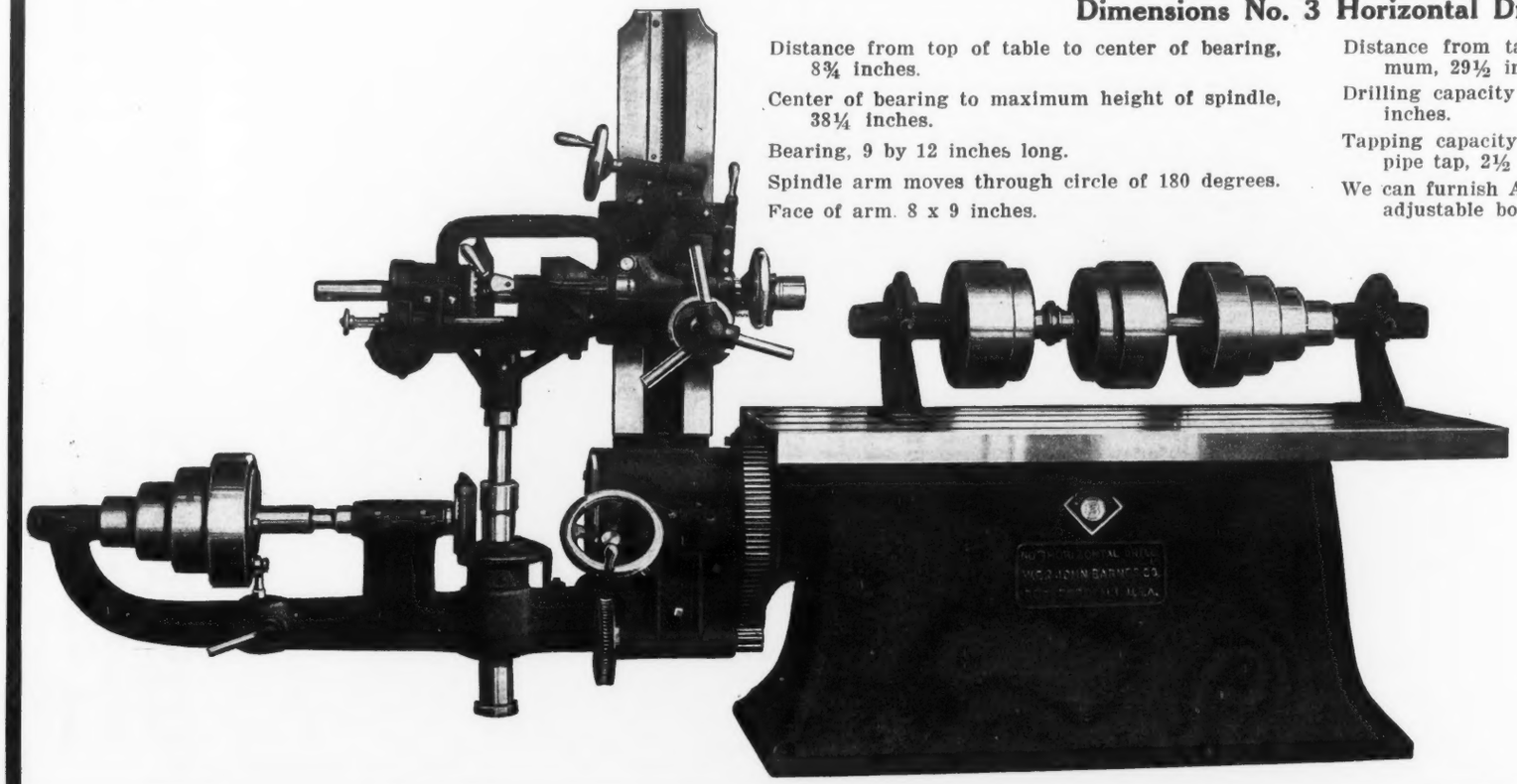
Face of arm, 8 x 9 inches.

Distance from table to center of spindle, maximum, 29½ inches, minimum 2⅜ inches.

Drilling capacity in solid C-I., 3 inches; steel, 2 inches.

Tapping capacity in C. I., 3 inches; capacity of pipe tap, 2½ inches.

We can furnish Arbor Rest (extra cost) which is adjustable both vertically and horizontally.



W. F. and John Barnes Co.

231 Ruby Street
Rockford
Illinois

SHIELD BRAND

REAMERS



HAND REAMERS IN SETS

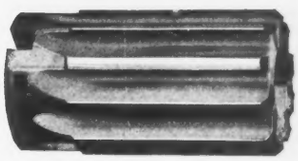
are distinguished by the better service they perform.

They are made with extreme accuracy and hold their edge longer than the average reamer.

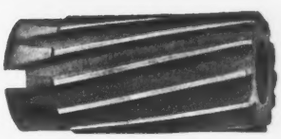
They are backed-up by forty-two years' experience in small tool manufacture.

Order them for your drilling requirements.

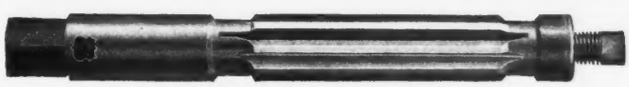
The Shield Appears On All Our Reamers



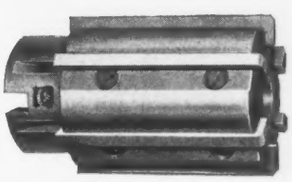
ROSE



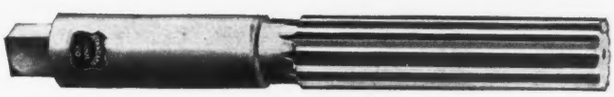
SPIRAL FLUTES



EXPANSION REAMERS



"STANAR" ADJUSTABLE



HAND REAMERS

THE STANDARD TOOL CO.

CLEVELAND

Branch Offices

New York Store, 94 Reade St.
Chicago Store, 552 W. Washington Blvd.
Boston, 1101 Scollay Bldg.
Philadelphia, 401 Liberty Bldg.

London, England, Burton Griffiths & Co., Ltd. Paris, France, Burton Fils. Geneva, Switzerland, J. Lambercier & Co. Copenhagen, Denmark, Nienstaed & Co. Tokyo, Japan, The F. W. Horne Co.

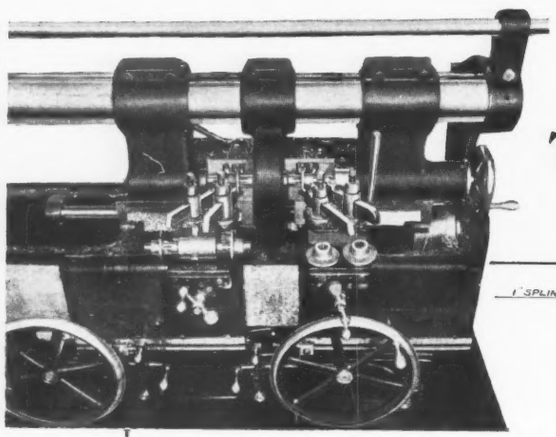
The New
DOUBLE END "SUNDSTRAND"

Sundstrand Double End Lathe is an efficient and accurate tool for turning simultaneously both ends of shafts, axle housings, etc., and manufacturing short pieces, as flanges, four-arm spiders, etc. It doubles output and halves production time on these classes of work.

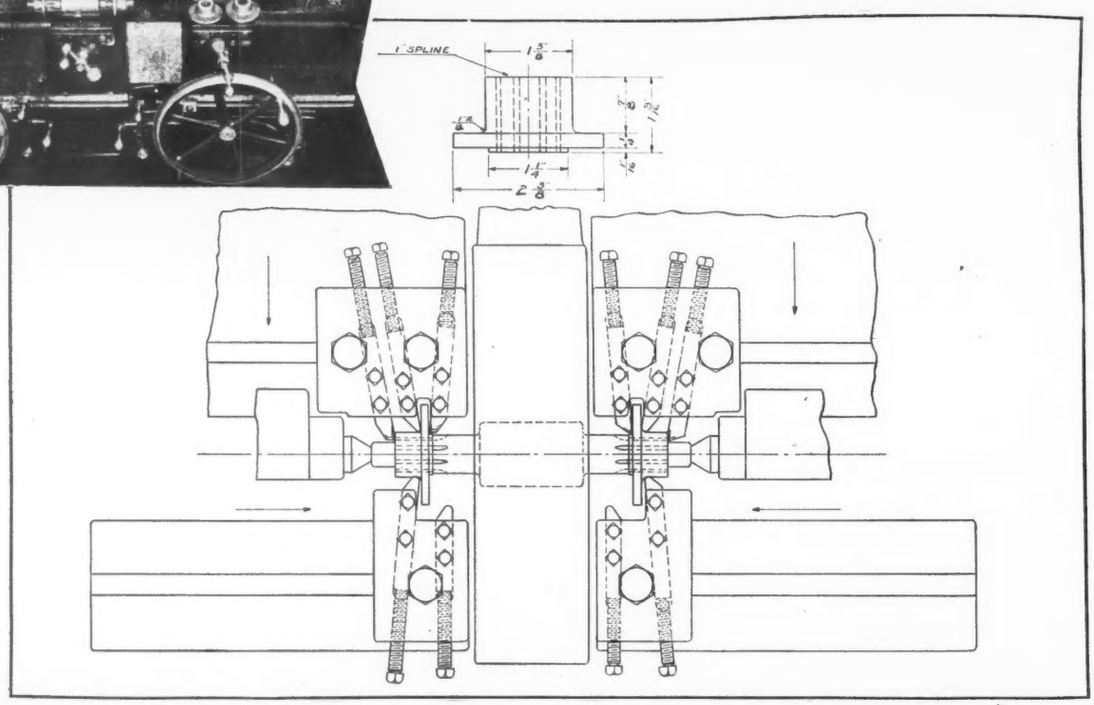
An example of duplicate manufacturing as performed by this machine is shown in diagram: Two universal joint flanges are held on a double-end arbor gripped in the center drive-chucking device. Two front and rear carriages carrying ten tools in this case, turn and face simultaneously. Carriages work toward each other and trip automatically. Two tailstocks and narrow center drive suspended from overhead arms slide along whole length of bed and account for Sundstrand's capacity for varying lengths of work.

Work is easily inserted and removed. Chips and lubricant fall freely into pan. Starting lever extends whole length of bed. Belt or motor drive—many other features we'd like to tell you about.

Send for Catalog and Full Particulars



Turning and Facing Flanges —Two at a Time



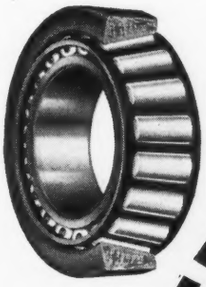
ROCKFORD MILLING MACHINE CO., Rockford, Ill., U.S.A.

DOMESTIC REPRESENTATIVES

Atlanta, Manning, Maxwell & Moore, Inc. Boston, Lynd & Farquhar Co. Buffalo, Homer, Strong & Co., Inc. Chicago, Manning, Maxwell & Moore, Inc. Cleveland, Co-operative Machinery Co. Cincinnati, Manning, Maxwell & Moore, Inc. Davenport, Mid-West Machine Tool & Supply Co. Dayton, M. D. Larkin Supply Co. Detroit, Manning, Maxwell & Moore, Inc. Grand Rapids, McMullen Machinery Co. Greensboro, N. C., Greensboro Supply Co. Houston, Texas, Manning, Maxwell & Moore, Inc. Kansas City, English Tool & Supply Co. Los Angeles, Herberts Machinery & Supply Co. Milwaukee, Western Iron Stores Co. Minneapolis, F. E. Satterlee Co. Montreal, Yeates Machinery & Supply Co. New York, Manning, Maxwell & Moore, Inc. New Orleans, The Fairbanks Co. Omaha, Interstate Machinery & Supply Co. Philadelphia, Manning, Maxwell & Moore, Inc. Pittsburgh, Manning, Maxwell & Moore, Inc. Rochester, Homer, Strong & Co., Inc. San Francisco, Herberts Machinery & Supply Co. Seattle, Wash., West Coast Mchy. Co. St. Louis, Manning, Maxwell & Moore, Inc. Syracuse, Manning, Maxwell & Moore, Inc. Toronto, Garlock Machinery Co., A. A. Jones & Shipman, Ltd., Alfred Herbert, Ltd. Windsor, Chas. A. Strelinger Co. of Canada, Ltd.

FOREIGN REPRESENTATIVES

Australia: Selson Engineering Co., London. England: A. A. Jones & Shipman, Ltd., New Century Works, Leicester. France: Louis Besse, 89 Rue de Lappe, Paris. Holland: Wynmalen & Hausman, Rotterdam. Japan: Roku-Roku-Shoten, Tokyo. Mexico: Annes & Sessums, Ave. F. I., Madero No. 1, Senna, Mexico D. F. Russia: M. Mett Engineering Co., Petrograd. Spain: Casamitjana Hermanos, Barcelona. Sweden: Aktiebolaget, Rylander & Asplund, Stockholm.



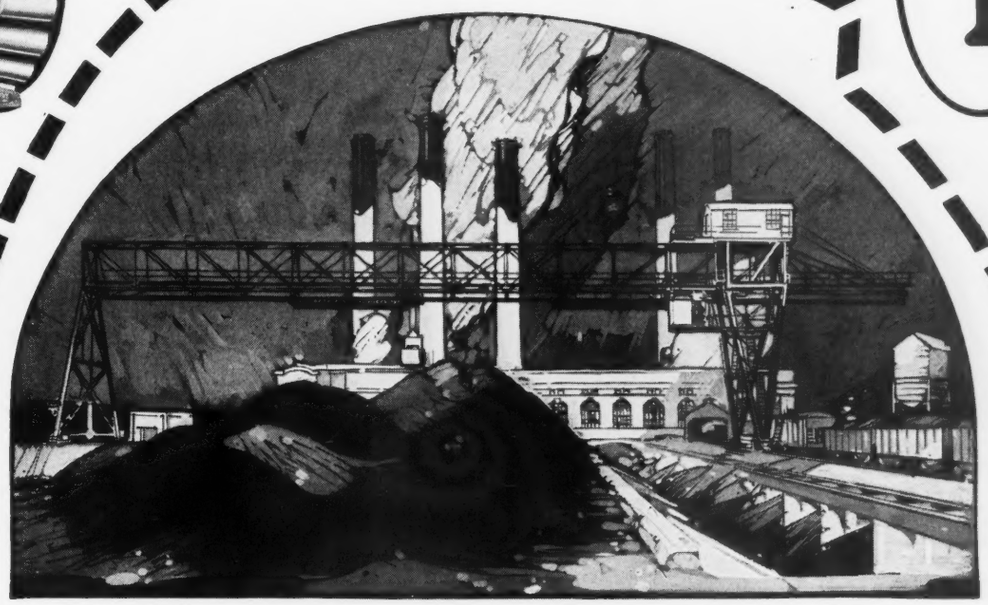


Illustration reproduced through the courtesy of the Brown Hoisting Machinery Co.

Material Handling with Timkens

In conveyors, Timken Tapered Roller Bearings save power, permit the use of a lighter weight and less expensive belt or chain, and prolong the life of the belt or chain.

In hoists and cranes, as in conveyors, the ability of Timken Bearings to carry radial loads, ***and*** thrust loads, ***and*** resultant loads provides for the sudden changes from one load to the other, when the hoisting operation is completed and the conveying operation begins.

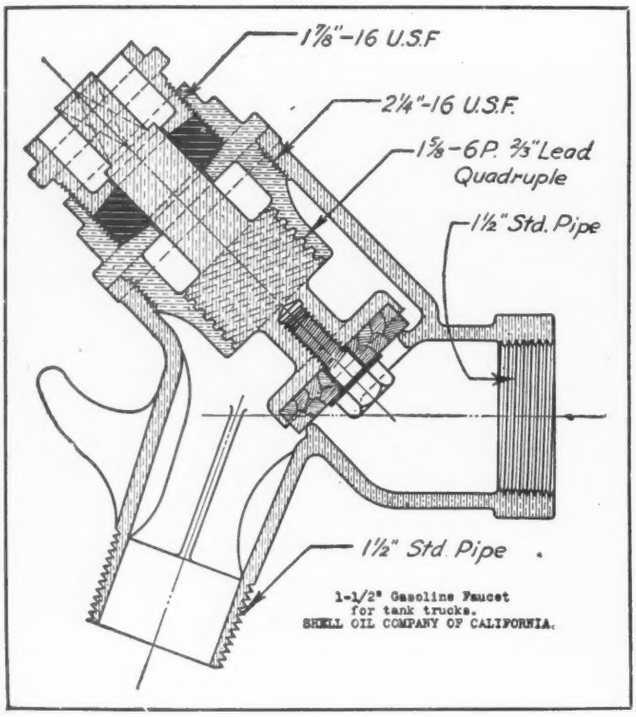
In all types of material handling machinery, Timken Bearings do away with the bugbear of frequent lubrication; wear in the running gears, idlers, etc., is confined to the bearings themselves; and when inevitable wear does eventually occur in the bearings, a simple, quick adjustment corrects it.

Naturally Timken-equipped material handling machinery includes such well known names as Robins, Brownhoist, Wellman-Seaver-Morgan, Godfrey, Chisholm & Moore, and others. For Timken Tapered Roller Bearings in material handling equipment, as in practically every other type of industrial machinery, are saving power, and trouble, and dollars.

The Timken Roller Bearing Co
CANTON, OHIO

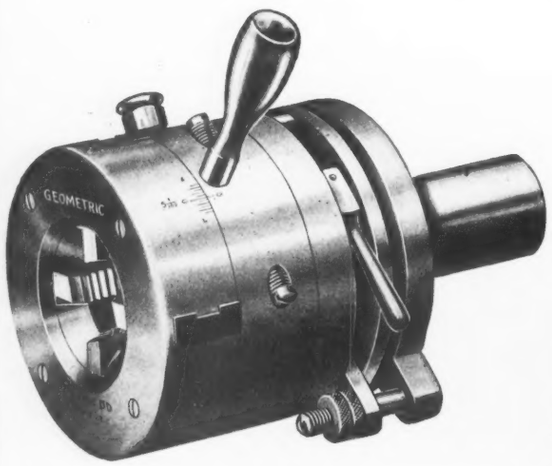
© 1923, The T R B Co, Canton, Ohio

TIMKEN
Tapered
ROLLER BEARINGS

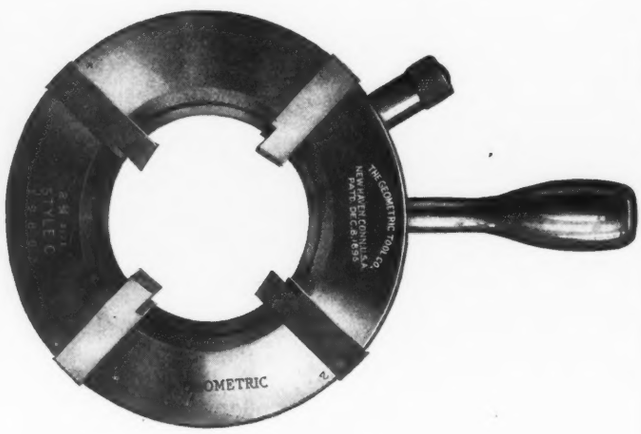


Five Threading Operations in Less than Two Minutes with Geometric Die Heads and Geometric Collapsing Taps

The Threaded Products Co., Oakland, California, manufacturers of specialties for oil producers, refiners, etc., declare that "Simplicity is the secret of practicality" and apply this dictum to the tools they use as well as the products they manufacture. Geometric Threading Tools—simple, practical, durable—profitably meet their needs. Study this drawing: five threads in two minutes is a fair sample of the work done here by Geometric Tools.



Get the details of Geometric Production on other work. Try a Geometric Tool at our expense.

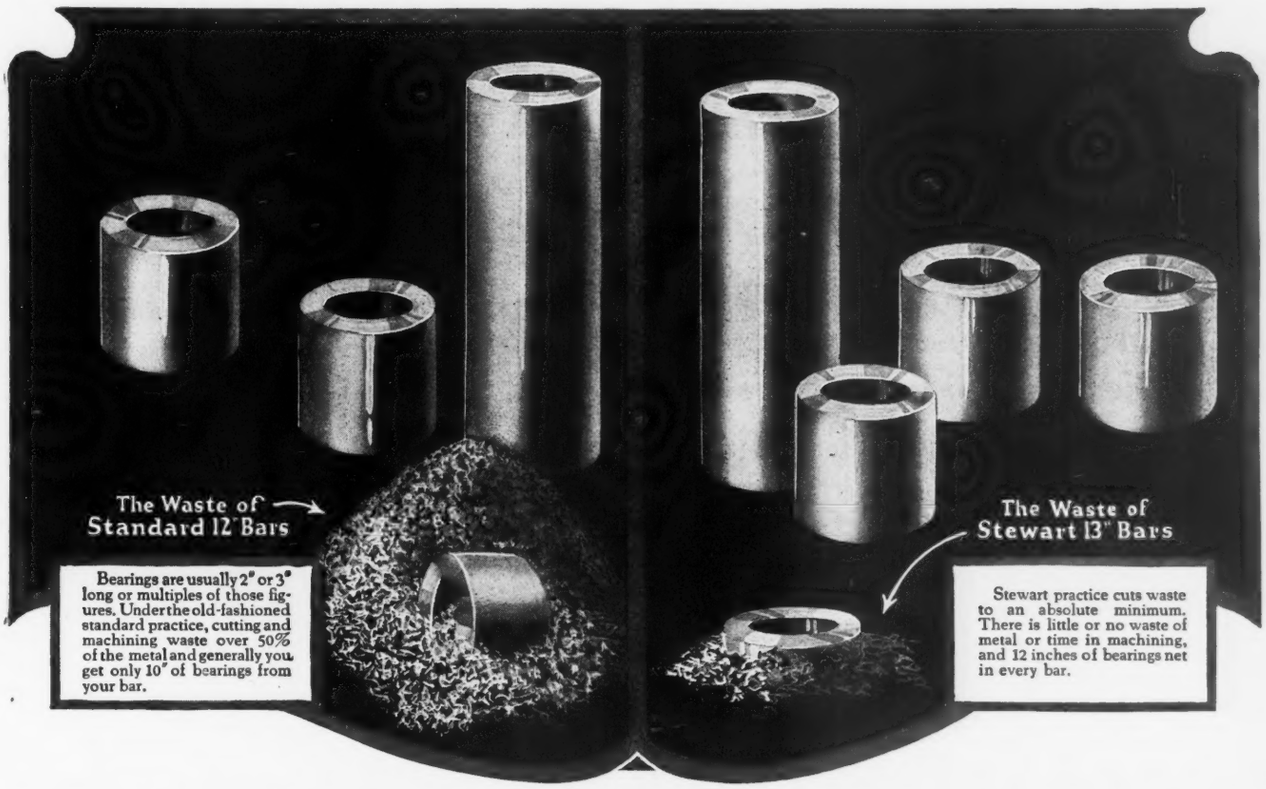


THE GEOMETRIC TOOL CO., New Haven, Conn.

General Distributors for Michigan, The Charles A. Strelinger Co., Detroit

WESTERN SALES AGENTS, The Tool Equipment Co., San Francisco. AGENCIES: Blackman-Hill-McKee Mchy. Co., St. Louis, Mo.; Federal Mchy. Sales Co., Chicago; Hill, Clarke & Co., Inc., Boston, Mass.; Kemp Mchy. Co., Baltimore, Md.; The National Supply Co., Toledo, O.; The W. M. Pattison Supply Co., Cleveland, O.; Root, Neal & Co., Buffalo, N. Y.; F. E. Satterlee Co., Minneapolis, Minn; Somers, Fitler & Tood Co., Pittsburgh, Pa.; Vandyck Churchill Co., New York and Philadelphia; Vonnegut Mchy. Co., Indianapolis, Ind.; The C. H. Wood Co., Syracuse, N. Y.; The Western Iron Stores Co., Milwaukee, Wis. CANADA: The A. R. Williams Mchy. Co., Ltd., Toronto, Vancouver (B. C.), Halifax (N. S.), and St. John (N. B.); Williams & Wilson, Ltd., Montreal. FOREIGN: Allied Machinery Co. of America, France, Italy, Switzerland, Spain, Portugal; Andrews & George, Tokyo, Japan; Bevan & Edwards, Melbourne. Buck & Hickman, Ltd., London, Birmingham, Manchester, Glasgow. Etablissements Horstmann, Paris; V. Lowener, Copenhagen, Christiania, Stockholm; Trading Co., R. S. Stokvis & Zonen, Rotterdam, Holland, and Brussels, Belgium; White & Rae, Sydney.





Why Waste 50% of Your Bearing Metal?

Our factory representatives below will give you complete information

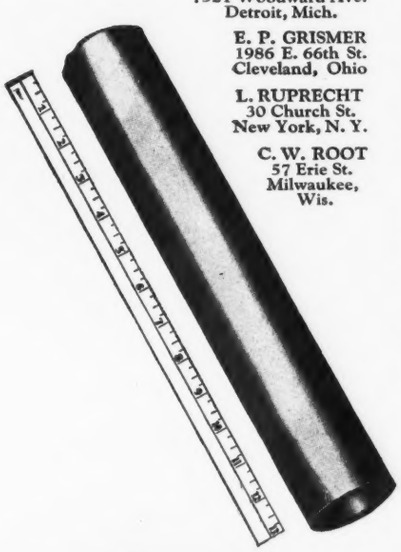
J. FRANK LANNING & CO.
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A. C. OLFS
7321 Woodward Ave.
Detroit, Mich.

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1986 E. 66th St.
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30 Church St.
New York, N. Y.

C. W. ROOT
57 Erie St.
Milwaukee, Wis.



THE picture above tells the story of the greatest improvement in bearing metal practice in years, originated by Stewart Manufacturing Corporation in conjunction with the development of Stewart Brons Bearing Metal.

You have always bought rough 12" bars. WHY? Generally you get only 10 inches of bearings from them. You lose over half your metal in machining and cutting. And you lose your machining time.

Buy a Stewart 13" bar and you get 12 inches of bearings. Stewart Bars are "FINISHED ALL OVER." We do your machining on a quantity basis, save all the metal, cut down your costs and give you more bearings for less money.

Pure Copper-Lead Bearings

More than that — when you buy Stewart Brons you have the most perfect bearing metal ever developed. We have learned how to mix copper and lead in any desired proportions, make the mixture uniform and proof against segregation.

It is a remarkable development — the perfect bearing metal. Absolutely will not score shafts. Functions perfectly at all low temperatures, and will not burn out. At 600° it sweats a little lead and lubricates itself. Even at 1000° we have never seen it score a shaft. Its melting point is 1700°. We carry 258 sizes of bars and bushings in stock in four grades of Brinell hardness to meet any requirements.

The success which Stewart Brons Bearing Metal has had since its announcement is remarkable. Every engineer should investigate its possibilities. We maintain an Engineering Department to co-operate with you. Our Service Department is at your disposal.

Jobbers! There is a wonderful market for Stewart 13" bars. Write for our proposition

STEWART MANUFACTURING CORPORATION
4503-88 Fullerton Avenue Chicago, Illinois

For detailed information write the factory direct or communicate with our nearest factory representative

Stewart Brons Bearing Metal

The Perfect Metal for Bearings

MURCHEY TOOLS

For speedy, economical threading use Murchey Die-heads. Long satisfactory service. They save time and money and cut manufacturing costs.

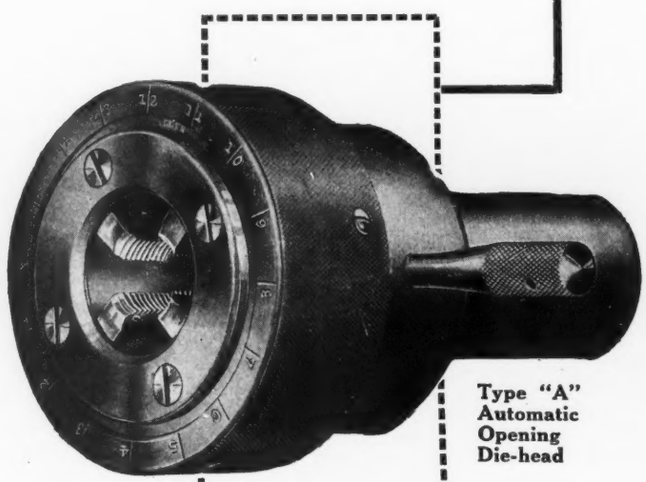
They are extremely accurate and require little attention. All parts are specially heat-treated, hardened and ground.

Self Opening Die-heads can be adjusted to .00025″ by means of a knurled index ring. Sizes from 3/32″ to 12″ capacity.

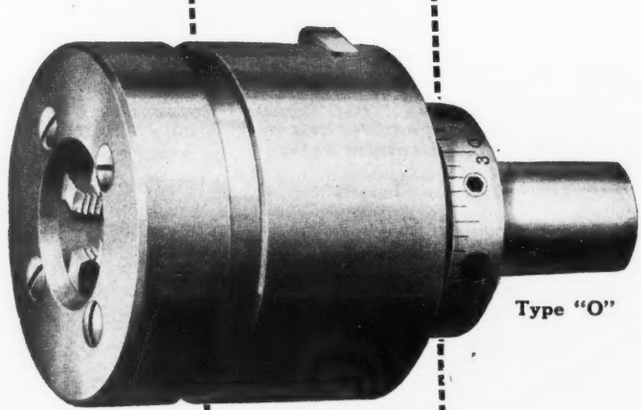
Murchey Standard Machine Taps range in size from 1¼″ to 12″, come in styles for both stationary and revolving spindle machines and thread all materials.

Murchey Tools are sent on approval. Try one on your work and in your own shop.

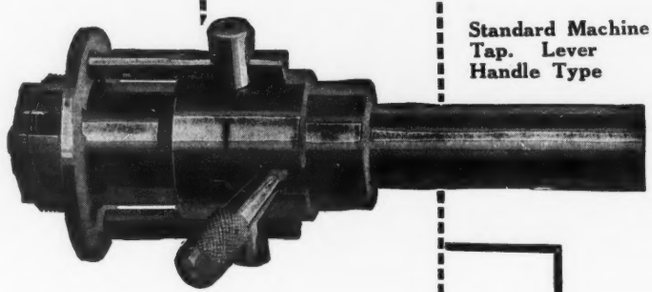
Or if you need special threading tools, we'll submit an estimate on receipt of drawings. Complete catalog on request.



Type "A" Automatic Opening Die-head



Type "O"



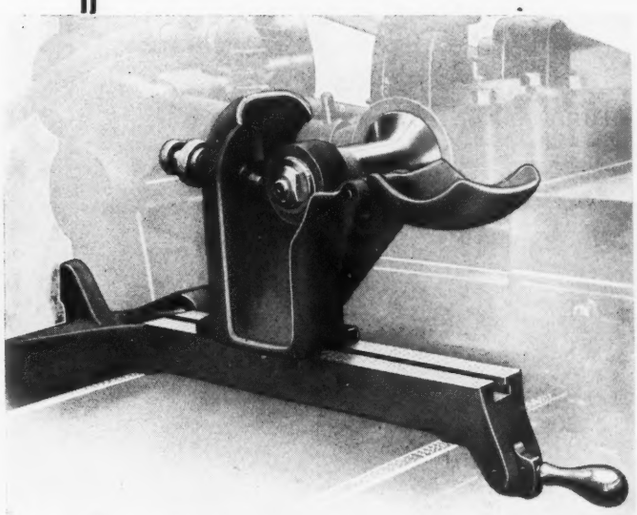
Standard Machine Tap. Lever Handle Type

Murchey Machine & Tool Company

34 Porter Street, DETROIT, MICH.

Cleveland Office, 6523 Euclid Ave. Pittsburgh Representative, Laughlin & Barney, 483 Union Trust Bldg. Chicago Representative, R. E. Ellis Engineering Co., 621 Washington Blvd. Smith-Booth-Usher, 50-60 Fremont St., San Francisco. Smith-Booth-Usher, 228 Central Ave., Los Angeles. Fenwick Freres & Company, 8 Rue de Rocroy, Paris. Coats Machine Tool Company, 14 Palmer Street, Westminster, London. S. W., England.

Truing the Wheel is a Simple Matter



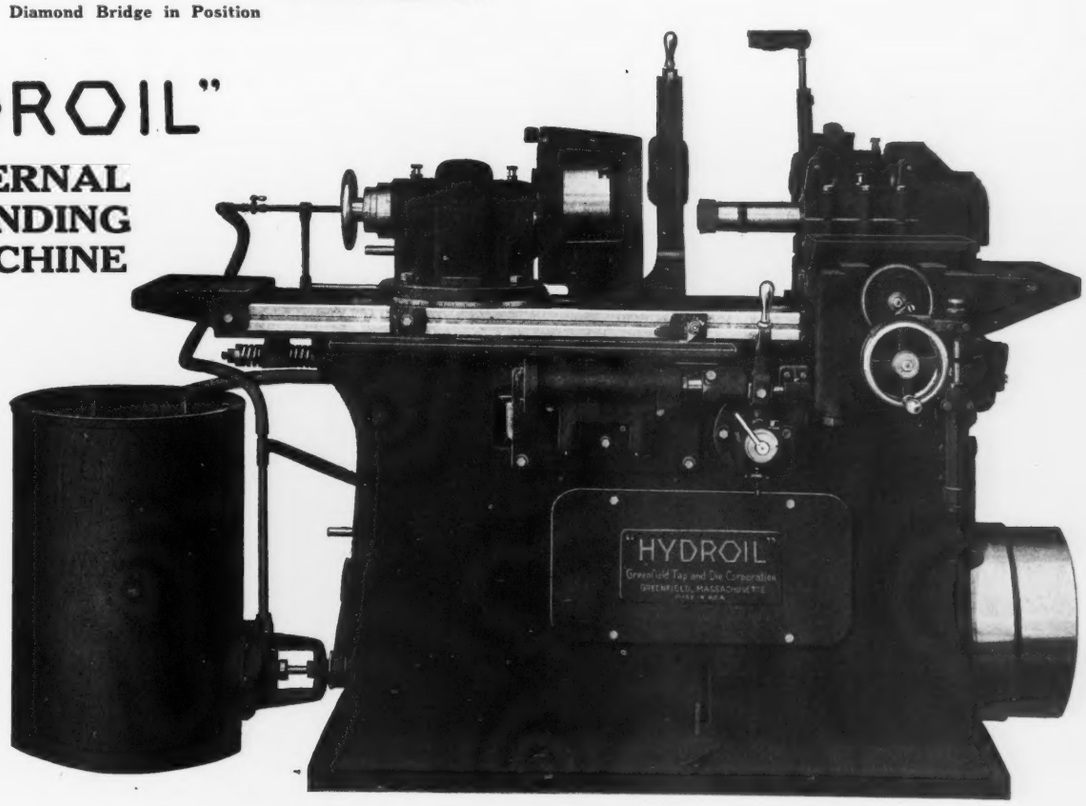
Diamond Bridge in Position

We've built a wheel truing device into the "Hydroil" Grinder which for simplicity and effectiveness can't be beaten. The diamond bridge is attached to a shaft mounted on the base of the machine at its back. When not in use, it swings back out of the way as in the lower illustration. When required, it is swung forward and down and instantly clamped to the work table by a cam. The diamond does its dressing upon the *back* of the wheel so that all dust is thrown *down* rather than up into the air. A water connection is provided for cooling the diamond and carrying away dust.

There are many other features in the "Hydroil" that combine to make it a most profitable machine on a wide range of internal grinding. Read about them in our new Grinding Machine Catalog No. 101. Send for it today.

"HYDROIL"

INTERNAL GRINDING MACHINE



GREENFIELD TAP AND DIE CORPORATION

GREENFIELD, MASSACHUSETTS

AGENTS—MANNING, MAXWELL & MOORE, INC.—New York, Philadelphia, Pittsburgh, St. Louis, Chicago, Milwaukee. STRONG, CARLISLE & HAMMOND CO.—Cleveland, Toledo, Detroit. SYRACUSE SUPPLY CO.—Syracuse, Rochester, Buffalo. E. A. KINSEY CO.—Cincinnati, Dayton, Indianapolis.

How great is your loss due to poor Pipe Threads?

It is easier and cheaper to make perfect pipe threads than it is to make poor ones if you have the right tap.



Hanson Process High Speed Pipe Taps

"Hanson Process" Pipe Taps are made either straight or taper type.

"Hanson Process" Pipe Taps are furnished correct in lead, correct in form of thread and correct in design. Lead correct to within .0001" per inch. Taps as accurate as finest pipe thread gauges.

Do you figure the cost of tapped holes or the cost of taps? We design taps for the material you are tapping. Let us know what work you are doing.

"HANSON" PROCESS

The Hanson Tap and Gauge Co.

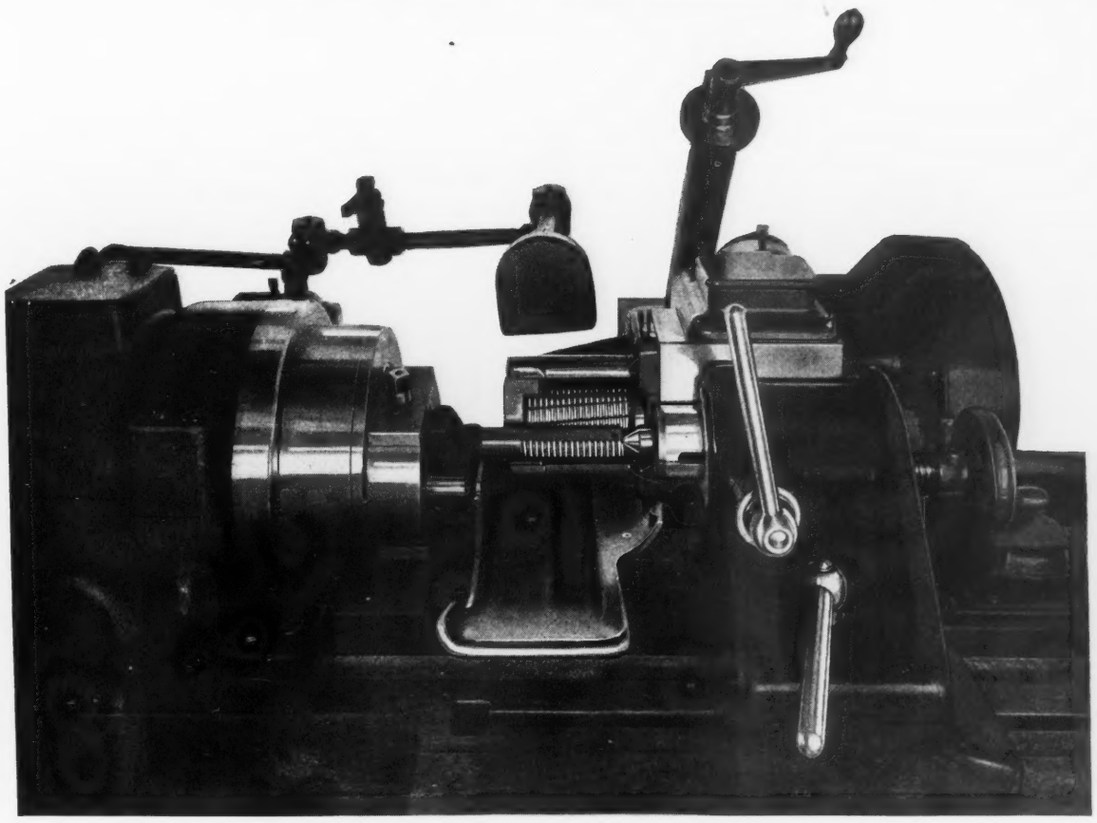
169 Bartholomew Avenue

HARTFORD, CONN.

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Philadelphia, Pa. ..... D. J. Normoyle
Pittsburgh, Pa. ..... William K. Stamets
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Detroit, Mich. ..... English & Miller Mchy. Co.
San Francisco, Cal. ..... A. H. Coates Co.

Universal Semi-automatic Thread Milling Machine



18" STILLSON WRENCH JAWS THREADED AT THE RATE OF 100 PER HOUR, FROM FLOOR TO FLOOR

This is one of many operations where the advantage of the "hurry-up" motion is apparent. After the thread is milled on one edge the work is instantly revolved to the position for threading the opposite edge.

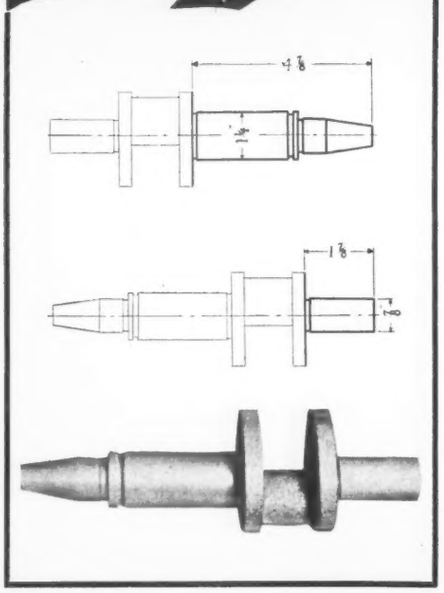
With this design it is possible to use small diameter hobs, thereby keeping down cost of cutting tools and obtaining a fine finish on the work.

The Hanson-Whitney Machine Co.

Hartford, Conn.

DOMESTIC REPRESENTATIVES: Selfreat-Woodruff Co., Cincinnati and Dayton, O.; English & Miller Machinery Co., Detroit, Mich. Wm. K. Stamets, Pittsburgh, Pa. and Cleveland, O.; D. J. Normoyle, Philadelphia, Pa.; L. C. Biglow & Co., Inc., New York City; George McPherson, Syracuse, N. Y. FOREIGN REPRESENTATIVES: Leo C. Steinle, London, England; R. S. Stokvis & Zonen, Rotterdam, Holland; Aktiebolaget Rylander & Asplund, Stockholm, Sweden; Fenwick Freres & Co., Paris, France; Brussels, Belgium; Turin, Italy; Barcelona, Spain, Rio de Janeiro, Brazil; Zurich, Switzerland. Andrews & George, Tokyo, Japan.





The Cost of These Parts Was Reduced One Third

So says a prominent manufacturer of Textile Machinery. A saving that every manufacturer, small or large, should be interested in.

Cut your costs and you can cut your price—secure more business and kill competition.

This phenomenal saving was done by

MACHINE TOOLS
REED-PRENTICE
WORCESTER, MASS. U.S.A.

PRODUCTION LATHES

The work was cast-iron eccentric shafts for "Comb Boxes."

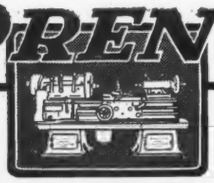
The former cost was 16 cents each.

The present cost (Reed-Prentice equipment) is 10 cents each.

The fact that while the ends of the shaft (tapering, grooving, etc.), are completed on the Reed-Prentice, the eccentric itself and the flanges are still turned on a fixture on the engine lathe gives even greater significance to the difference in production cost.

Reed-Prentice Production Lathes lower manufacturing costs on all kinds of lathe work. If you are interested in *increasing profits* we can give you interesting data on a wide variety of parts produced on these machines.

REED-PRENTICE CO.

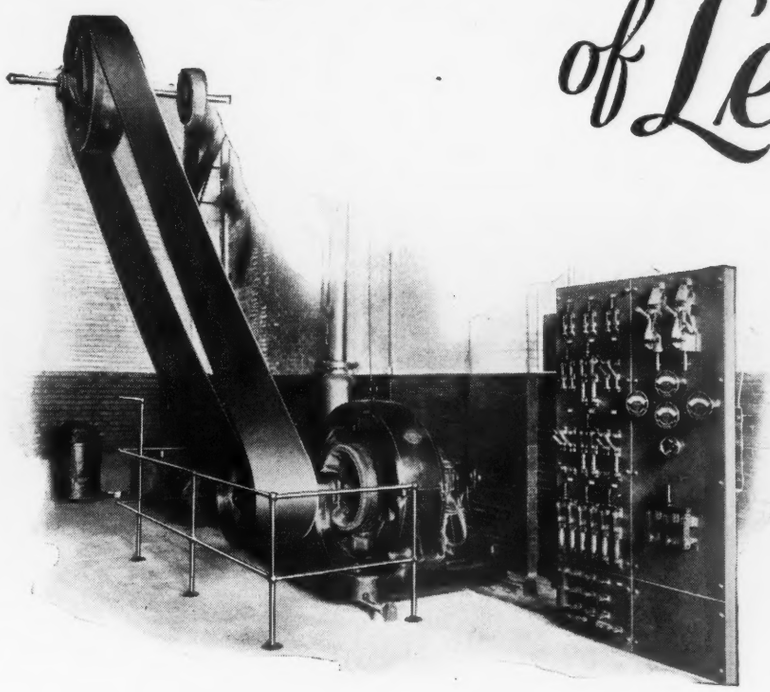


LATHES-RADIAL DRILLS
BECKER MILLING MACHINES
MILLING CUTTERS

RAPID PRODUCTION LATHES
WHITCOMB PLANERS
SPECIAL MACHINERY

WORCESTER, MASS.
677 CAMBRIDGE ST.,
Branch Offices and Agents Throughout the World

Nothing takes the place of Leather



$5000.00 in PRIZES for Letters about Leather

THE sole and belting leather tanners of America jointly plan to tell the truth about leather to the public.

People, in general, need to know the facts about this basic industry, and ought to realize the conditions under which it exists. So the tanners intend that their product, and their policies, shall now be frankly and fully explained.

For such a purpose, the principal producers of leather have provided funds to carry out a broad publicity campaign, in various forceful, informing ways. Through advertising space, in the principal popular periodicals, the tanning industry will make its position plain.

Among other vital facts which affect everybody, this one in particular shall be made evident:

"Nothing takes the place of leather" for machinery belting.

You are concerned in having this assertion substantiated. You are urged to consider the evidence the tanners will submit. You will then be able to give a verdict on the proved facts.

During this August

over 29,000,000 copies of America's favorite weekly and monthly magazines will publish the details of a Contest, open to anyone, anywhere, offering

$5000.00 in Cash Prizes for Letters about Leather

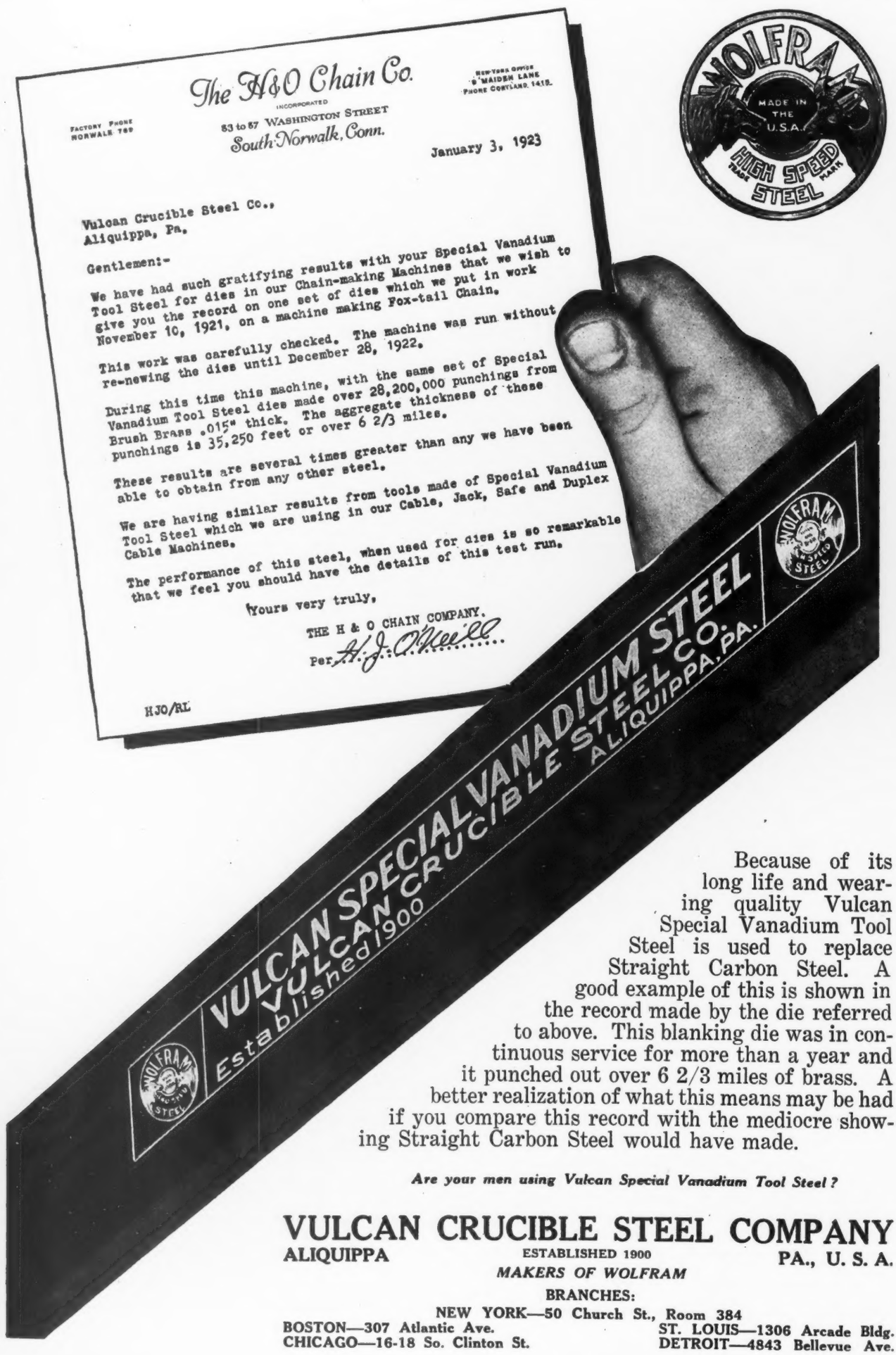
First prize $2,000.00 in cash—one hundred seventeen other cash prizes

Help somebody you know to win!

AMERICAN SOLE AND BELTING LEATHER TANNERS

17 Battery Place, New York City

Representing a group of independent, competing makers of leather, who buy their raw material in open market against the bidding of all the world; who do business unaided by any subsidy, and with no advantage through any tariff; whose hazards are abnormally great, but whose margin of profit is abnormally small.



Because of its long life and wearing quality Vulcan Special Vanadium Tool Steel is used to replace Straight Carbon Steel. A good example of this is shown in the record made by the die referred to above. This blanking die was in continuous service for more than a year and it punched out over 6 2/3 miles of brass. A better realization of what this means may be had if you compare this record with the mediocre showing Straight Carbon Steel would have made.

Are your men using Vulcan Special Vanadium Tool Steel?

VULCAN CRUCIBLE STEEL COMPANY

ALIQUIPPA ESTABLISHED 1900 **PA., U. S. A.**

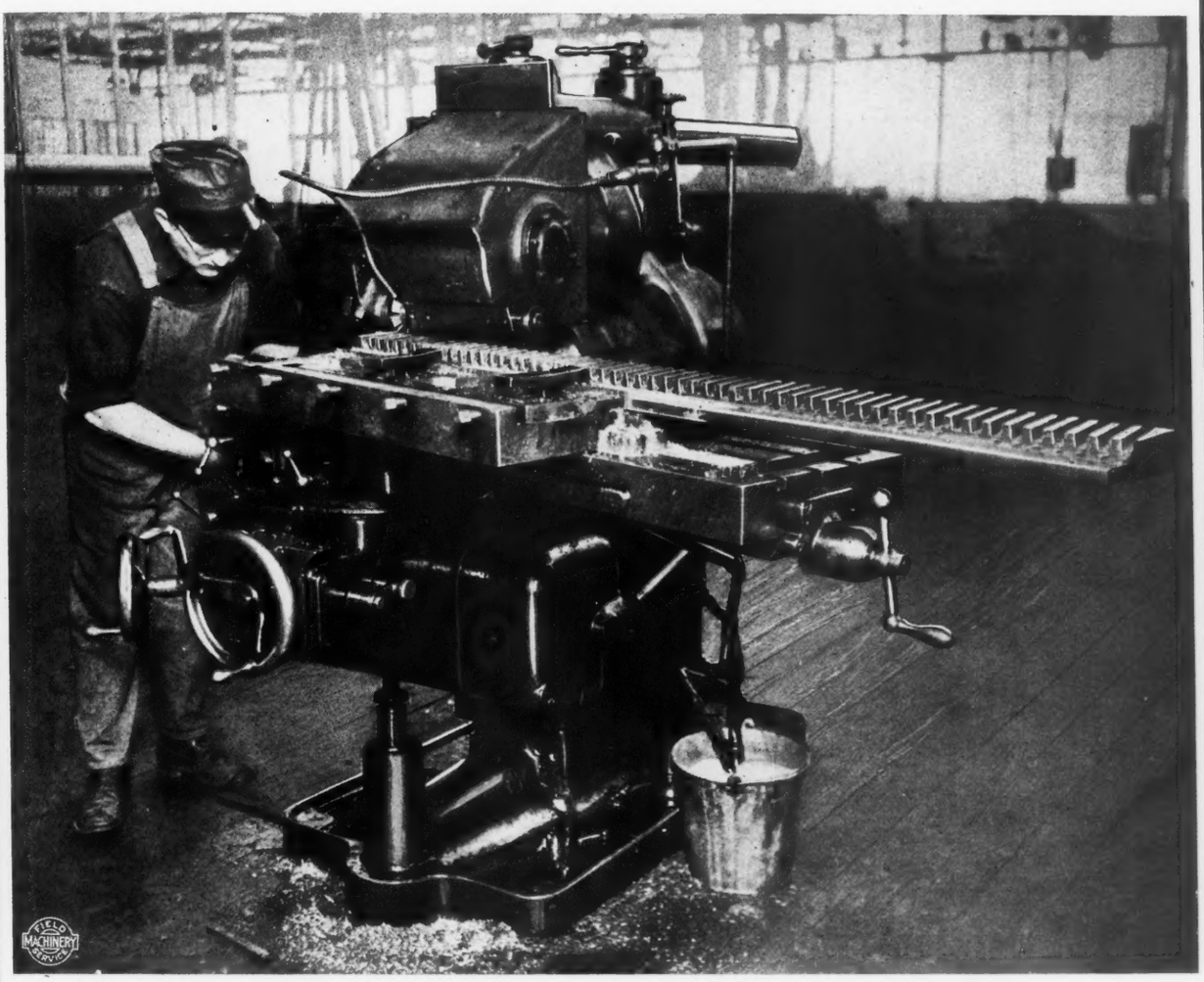
MAKERS OF WOLFRAM

BRANCHES:

NEW YORK—50 Church St., Room 384

BOSTON—307 Atlantic Ave. **ST. LOUIS—1306 Arcade Bldg.**

CHICAGO—16-18 So. Clinton St. **DETROIT—4843 Bellevue Ave.**



For Accurate Heavy Cuts

This shows a No. 2 Ryerson-Conradson Universal Milling Machine cutting a section of a special herringbone rack for a planer. The teeth are .720″ deep and are finished to a close degree of accuracy in a single cut. The modern design, wide range, extremely accurate construction and operating efficiency of this Ryerson-Conradson Miller are characteristic of all our machine tools. "Ryerson Machinery" means high grade production tools that meet the best standards for modern metal working equipment, in a range that covers the needs of practically every class of work.

We would be glad to send you complete information on any machines which are of interest to you.

JOSEPH T RYERSON & SON INC.
Established 1842

Plants: CHICAGO ST. LOUIS CINCINNATI DETROIT BUFFALO NEW YORK
Branch Offices: Minneapolis Milwaukee Denver Tulsa Houston San Francisco

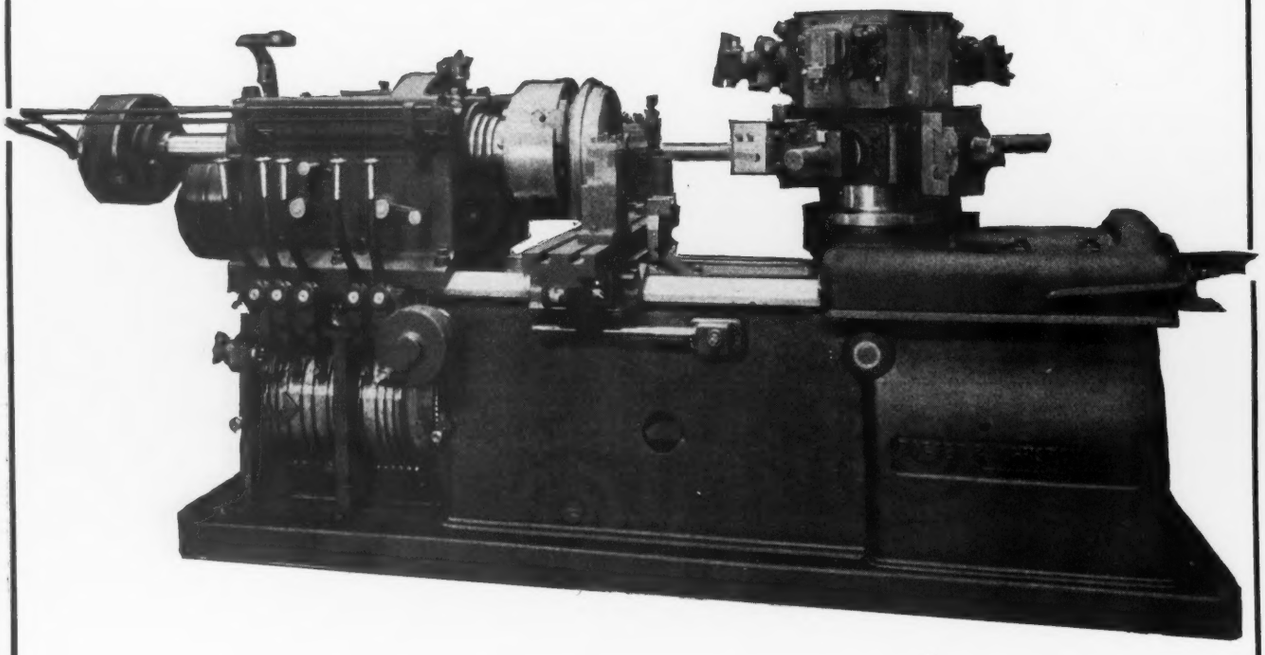
RYERSON MACHINERY

Announcement

of the

Potter & Johnston New Model Machine

6-C AUTOMATIC



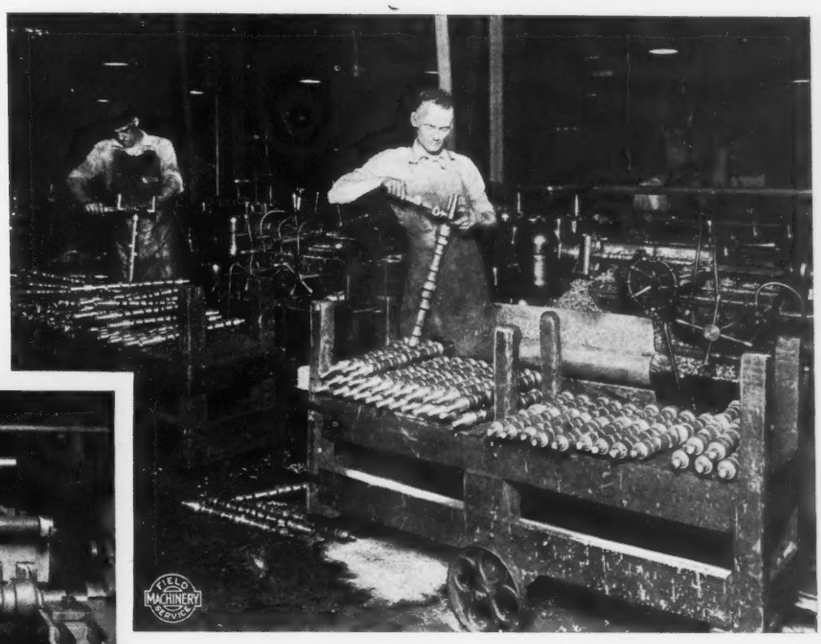
The Potter & Johnston 6-C Manufacturing Automatic Chucking and Turning Machine is the latest development in the P. & J. Automatic line and has been designed especially for the **Economical Production** of Flywheels, Hubs, Electric Motor Parts, etc., within its capacity where accuracy and power are required.

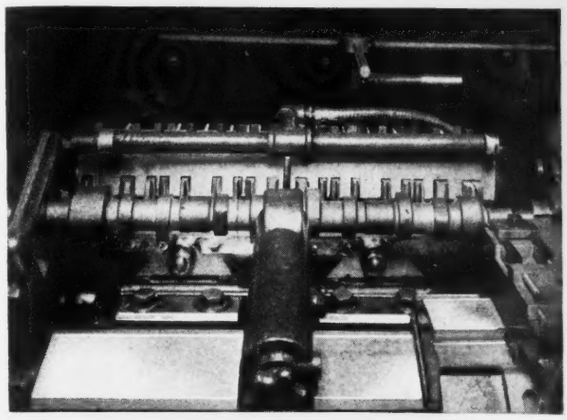
Send for your copy of bulletin No. 57.

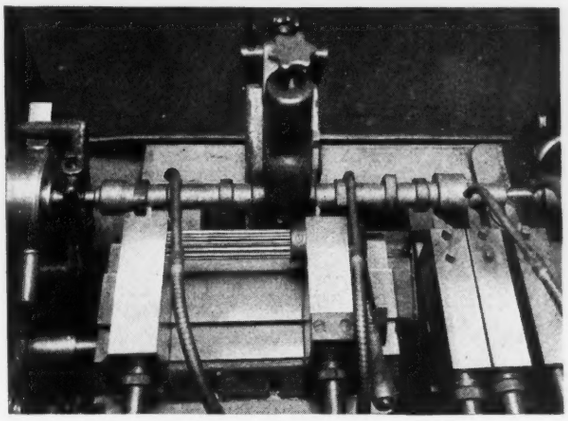
POTTER & JOHNSTON, Pawtucket, R.I., U.S.A.

DOMESTIC OFFICES: New York Office—Hudson Terminal Building, 50 Church St. Walter H. Foster, Manager. Detroit Office—The Potter & Johnston Agency Co., 535 Bates St. Chicago Office—3057 Eastwood Ave. Leslie J. Orr, Manager. Pacific Coast Office—Rosslyn Hotel Los Angeles, Cal. Charles H. Shaw, Manager. FOREIGN REPRESENTATIVES: L. J. Colomb, 68 Avenue de la Grande Armee, Paris, France. Representative for France, Belgium, Switzerland, Spain and Portugal. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland, Ercole Vaghi, Corso Porta Nuova, 34 Milan, Italy. Rylander & Asplund, Stockholm, Sweden. Yamatake Company, No. 1 Yuracucho, Ichone, Kojimachiku, Tokyo, Japan.

Lo-swing Beats Its Own Record







They thought they knew what production meant at the Jackson Motor Shaft Company, Jackson, Michigan, with 13 **Lo-swing** Lathes (3½" model) in constant operation, but the installment of these two new 4" models showed them that even the best machines may advance with the times.

Cam shafts 24 13/22" long of 3½% nickel steel come to the first of the two 4" **Lo-swing** Lathes with the center bearing turned and both ends faced and centered. Here they are faced between cams and turned on one main bearing and one end. Time, 1 minute 17 seconds floor to floor. The close up shows the 19 rear facing and 2 front turning tools.

The second operation (on the second new **Lo-swing**) is turning between the cams, one main bearing and the opposite end of the shaft. Time 1 minute, 45 seconds; close up shows the five turning tools.

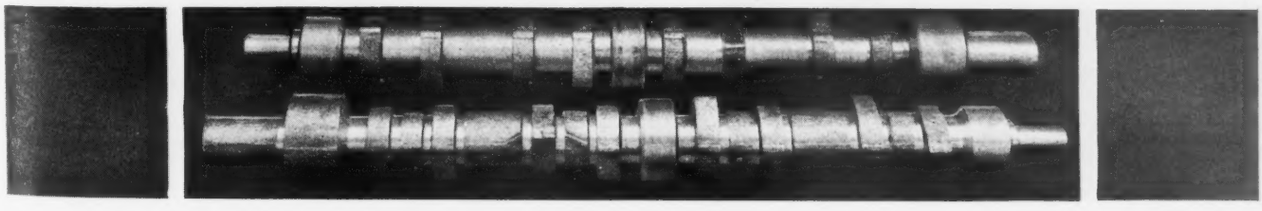
This performance is better than the best estimates for competing machines; incidentally these two new model 4" **Lo-swing** Lathes are now handling the same amount of work that was formerly performed on three old 3½" **Lo-swing** and two engine lathes.

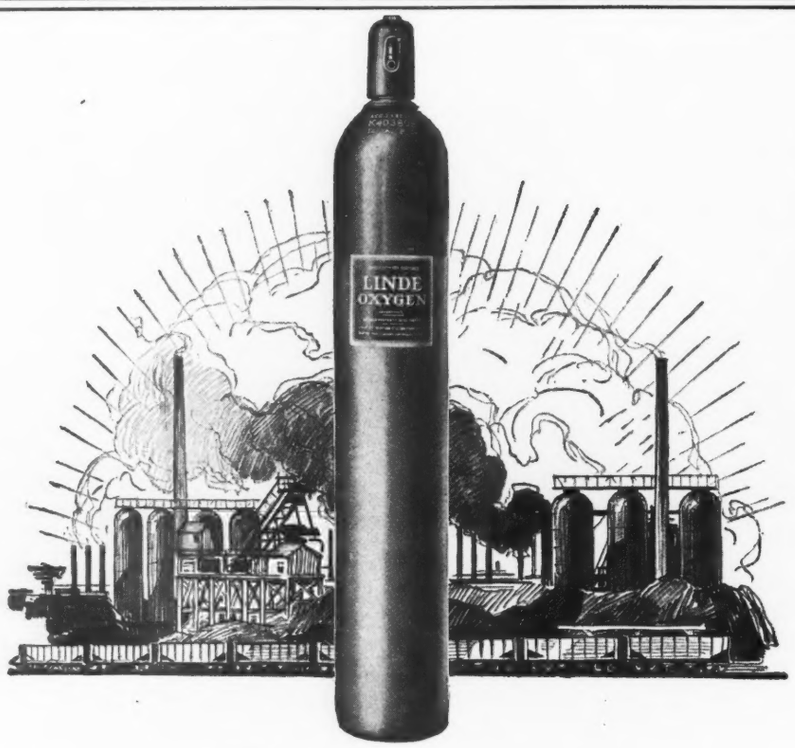
Fitchburg Machine Works

FITCHBURG, MASS.

REPRESENTATIVES: Detroit and Cleveland District, W. H. Nettle, 236 Richton Ave., Highland Park, Detroit, Mich. Chicago, Milwaukee and St. Louis District, W. A. McCarrell, 429 Kenwood Boulevard, Milwaukee, Wis. New York State District, W. H. Dana, 137 E. Brighton Ave., Syracuse, N. Y. France, Italy and Belgium, G. E. Fogarty, 42 Rue le Peletier, Paris 9e, France. Norway, Sweden and Denmark, Aktiebolaget Servus, Kungsgatan 28, Stockholm, Sweden. British Isles—Buck & Hickman, Ltd., 2 and 4 Whitechapel Road, London E 1, England.

The new Lo-swing keeps "production up-to-date." Let us give you estimates





Linde Engineering Service for Linde Users

Linde users seldom fail to save time and money by availing themselves of Linde Engineering Service.

Better standards of practice are often suggested. New applications are pointed out. The vexing problem may be a common one which Linde has helped to solve many times.

The field work with Linde users is carried on through the District Sales Office in that locality, and is based upon the vast knowledge of the whole Linde organization in the uses of oxygen, resulting from many years' experience. The resources of the Linde Engineering Staff and Research Laboratories are called upon when necessary.

For your convenience 31 plants and 58 warehouses

THE LINDE AIR PRODUCTS COMPANY
Carbide and Carbon Building, 30 East 42d St., New York City

The Largest Producer of Oxygen in the World

District Sales Offices:

Atlanta	Chicago	Detroit	New Orleans	Pittsburgh
Baltimore	Cleveland	Kansas City	New York	San Francisco
Boston	Dallas	Los Angeles	Philadelphia	Seattle
Buffalo		Milwaukee		St. Louis

LINDE OXYGEN



Note this Advantage

A distinctive feature of this Wetmore Shell Reamer is the 1/8" projection of the blades over the end of the reamer body for chip clearance. This allows the chips to fall off ahead of the reamer body and prevents chips from clogging up along cutting edge of blades.

Another WETMORE REAMER that Cuts Production Costs

Here is the famous *Wetmore Expanding Shell Reamer*, the reamer that helped so many production men turn out more work at less cost—and in less time—during the rush periods of 1922.

Now, again—this is one of the most popular of the Wetmore line. It is turning out job after job that other reamers have fallen down on. More than one user has told us that this Wetmore Shell Reamer has done work which they thought would stump any reamer.

That's why we say: The *Wetmore Expanding Shell Reamer* is guaranteed, absolutely, to lower your production costs. It does quicker work—the reamer stands up longer—blade replacement costs are cut.



WETMORE
Replacement Blades

The method of holding the blades on the Wetmore Shell Reamer eliminates unnecessary extra parts. This saves time and simplifies the replacement and adjustment of blades.

All Wetmore blades are scientifically ground for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

This Wetmore Shell Reamer is adaptable for either line or pilot reaming. Fits all standard bars and shell reamer arbors. Body, lock nut and cone nut are finest heat-treated alloy steel. Has .087" expansion. Made in these sizes: 1¼" to 3", 6 blades; 3 1/16" to 5", 8 blades; 5 1/16" to 6", 10 blades. Made also with straight hole, if desired. Left-hand blades are staggered to eliminate chattering.

Send for FREE Catalog.

Write for Wetmore Catalog, showing full line of standard, heavy duty, shell, small machine and cylinder reamers. Also arbors and replacement blades. Sent *free, postpaid*—no obligation to you.

WETMORE REAMER COMPANY

MILWAUKEE, WISCONSIN

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"



INSEPARABLE

IF YOU SAY "ARMSTRONG" TO A MACHINIST HE WILL THINK, TOOL HOLDER

Thirty years of honorable association have made the words almost inseparable in his mind to which they also suggest Convenience, Economy and Efficiency. This also explains why Dealers find that among their customers 90% of the demand is for ARMSTRONG TOOL HOLDERS.

ARMSTRONG TOOL HOLDERS

SAVE High-Speed Steel
Time
Grinding Wheels

INCREASE PRODUCTION

SPECIFY ARMSTRONG when ordering AND GET THE BEST

Write for free catalog.

ARMSTRONG BROS. TOOL CO.
"THE TOOL HOLDER PEOPLE"
313 N. FRANCISCO AVE. CHICAGO, U.S.A.

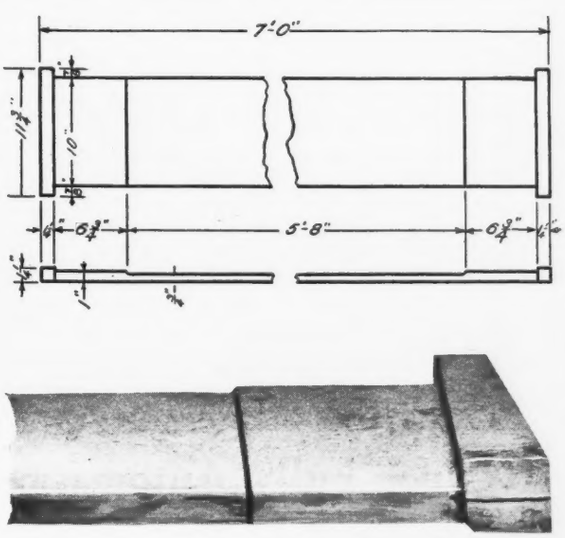
AJAX INSTALLATIONS Lower Costs

THIS NEW MODEL 5″ Ajax Upsetter at the Joliet Railway Supply Company, Chicago, Ill., has materially lowered the cost of these steel straps for Huntoon Blosters.

The piece was formerly bought from a contract shop at a price which allowed for the laborious operation of drawing it down from 1¼″ x 12″ stock under the hammer. Now it is produced "at home" on the 5″ Ajax by upsetting the ends of ¾″ x 10″ stock.

The size of the ends necessitates a preliminary stock gathering and a finishing operation. *The great vertical die space* of the 5″ Ajax accommodates both these operations in a two high die so that an end can be completed at one heat and one handling, eliminating the second die and tool set-up, and the additional heating and handling which the ordinary forging machine would require.

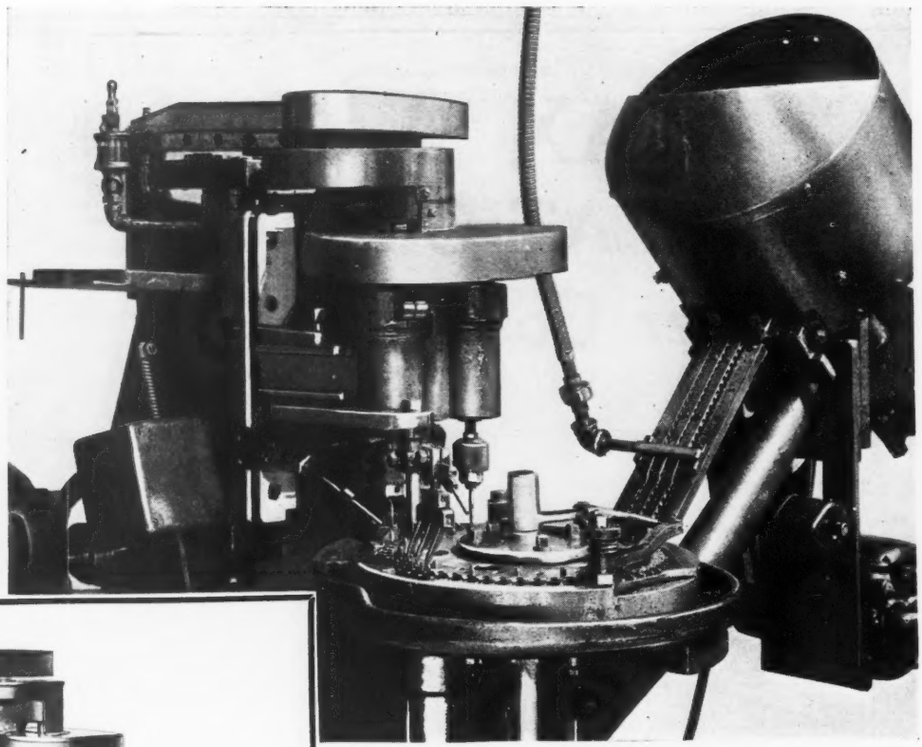
Let us show you how the installation of an Ajax would lower your costs.

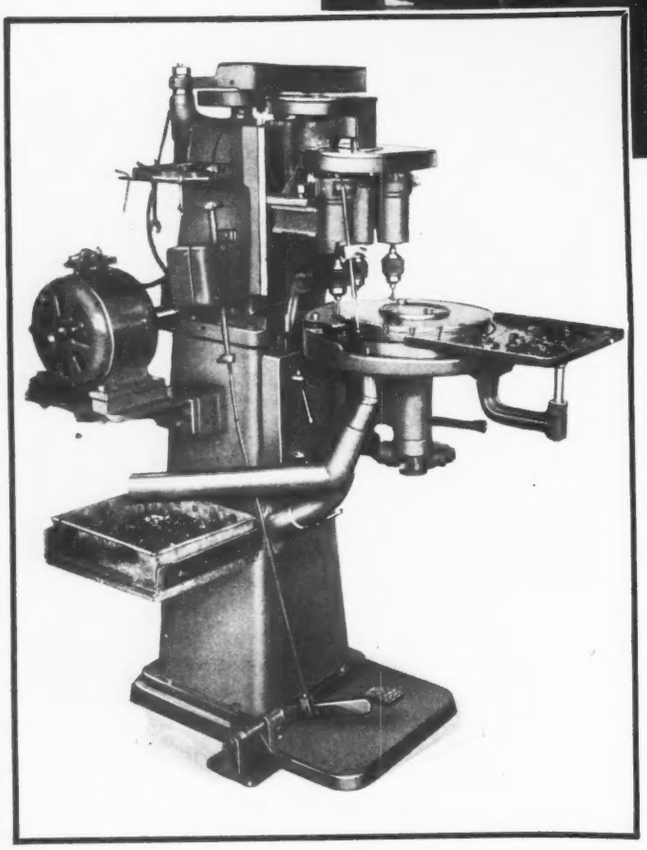


The Ajax Manufacturing Company
621 Marquette Bldg.
CHICAGO, ILL.
1369 Hudson Terminal
NEW YORK CITY
CLEVELAND, OHIO

AJAX

(Trade Mark Registered)





The standard Anderson Dial Feed Tapping Machine is semi-automatic, that is, an operator is required to load and unload the work. It is a remarkably efficient machine, run at a predetermined speed, which will maintain its output hour after hour. It handles a considerable range of work, with one, two or three holes, and all three taps can be of different lead if required.

Let us tell you all about Anderson machines; send samples for estimates.

An Attachment that Makes the Anderson Tapper Fully Automatic

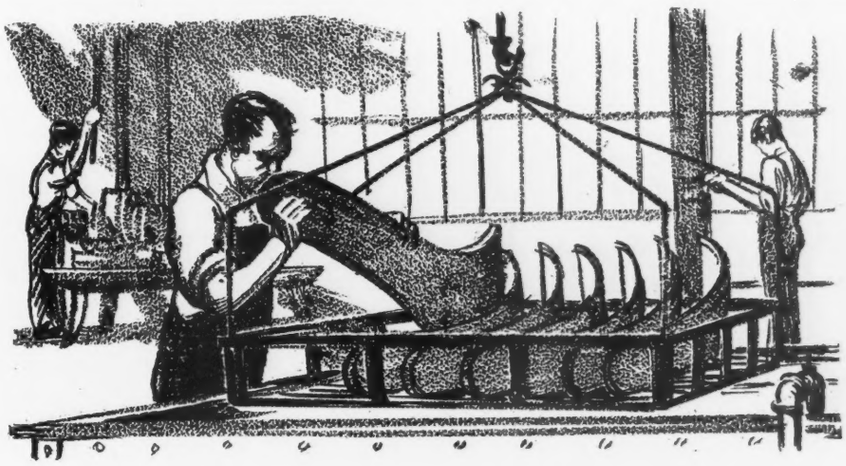
A full automatic can be made of the Anderson Dial Feed Tapping Machine by combining with it a hopper feeding attachment as shown. This particular machine was developed for tapping battery thumb nuts; but the automatic feed can be arranged for other similar classes of work.

The hopper has a chute with three raceways; the machine has three tapping spindles; the feeding dial, with 54 openings, is indexed by an 18 tooth ratchet; one movement of the dial, therefore, puts three nuts under the three spindles; a positive ejector removes the completed work.

The machine is timed to run 40 strokes per minute giving a theoretical production of 120 pieces per minute, 7200 per hour. On actual production three of these machines, running on a 20 hour schedule, tap 375,000 to 421,000 pieces per day.

THE ANDERSON DIE MACHINE COMPANY

BRIDGEPORT, CONN.



How much work will a pound of cleaning material do?

10 lbs. of Oakite materials cleans 480 auto fenders and other large sheet steel parts in one of the best known auto factories.

The job calls for the removal of oil and grease before japanning. It must be done right, to pass inspection and avoid rejects. A 10-minute immersion of these pieces in a thousand gallon tank does the work so well that not a single piece has been turned down on account of poor cleaning since they started using Oakite.

Oakite materials cost them slightly less than 1 cent for every 3 parts **perfectly** cleaned. That's economy!

Your own cleaning work may be quite different. It probably is. But no matter what kind of a metal product you may be making, you are doubtless just as interested as the foreman and superintendent of this plant were to get the most work you can out of each pound of cleaner you use.

It is likely that out of our experience in serving more than 14,000 plants in 52 different industrial classifications, we can offer you some valuable suggestions about cleaning methods, equipment or materials that will considerably reduce your cleaning costs.

When two practical men get together, each backed by his own special experience and knowledge, ways and means for improving methods are bound to be uncovered. One of our cleaning specialists will be glad to cooperate with you. Write us when you would like to have him call.

There are 70 Oakite Service Men, cleaning specialists, located at: Allentown, Pa.; Baltimore, Boston, Bridgeport, *Brooklyn, Camden, Cedar Rapids, *Chicago, *Cincinnati, *Cleveland, *Dallas, Dayton, *Denver, *Des Moines, *Detroit, Erie, Evansville, Ind.; Grand Rapids, Greenville, N. C.; Harrisburg, Hartford, *Indianapolis, *Kansas City, Lansing, *Los Angeles, Louisville, *Milwaukee, *Minneapolis, *Montreal, Newark, New Haven, *New York, *Oakland, Philadelphia, Pittsburgh, Portland, Me.; Poughkeepsie, *Providence, Reading, Rochester, Rockford, *Rock Island, *San Francisco, Schenectady, *Seattle, *St. Louis, Toledo, *Toronto, Utica, Waterloo, Williamsport, Pa.; Worcester.

*Stocks of Oakite materials are carried in these cities.

Write for our booklet "Modern Metal Cleaning"

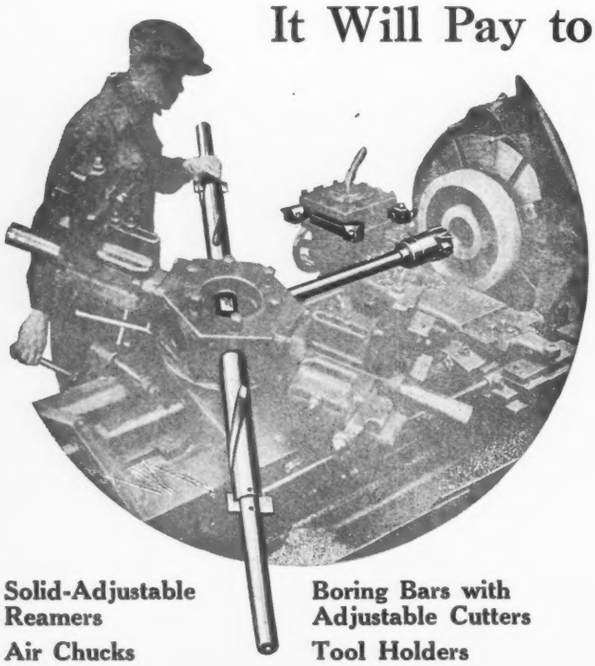


Oakley Chemical Co. *General Offices:* **26 Thames St., New York, N.Y.**

OAKITE

Industrial Cleaning Materials

It Will Pay to Fit your Turret Lathes with GISHOLT BORING BARS



Solid-Adjustable Reamers
Air Chucks

Boring Bars with Adjustable Cutters
Tool Holders

Gisholt Boring Bars can be depended on to keep up their end of the work. Ample chip clearance eliminates all danger of cutters breaking from clogging chips; unusual rigidity is secured by locating the slot and pin so the cutter leads the largest diameter of the bar itself. Bars are machined in jigs and cutters are interchangeable, so no time is lost fitting new cutters when occasion requires.

Cutters are made solid or adjustable. Oil tubes deliver coolant to the cutters. Bars for holes from 1 inch to 9½ inches.

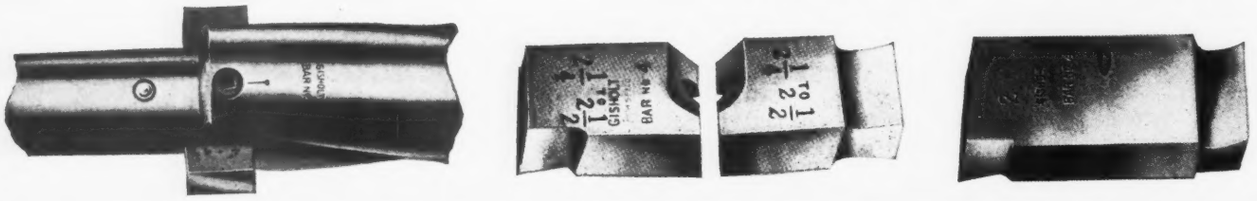
Send for descriptive circular

GISHOLT MACHINE COMPANY

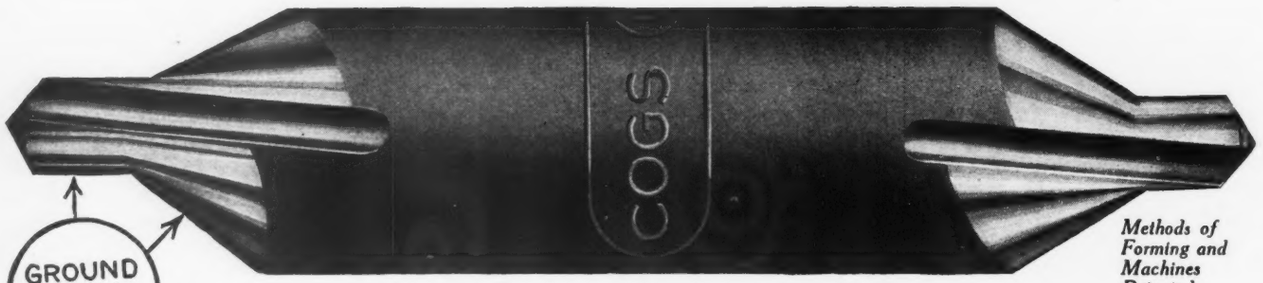
9 South Baldwin Street **MADISON, WISCONSIN**

Eastern Office:
Room 1725, 30 Church St.
New York City

Cleveland Office:
1888 Page Avenue
Cleveland, Ohio



COGS DRILL Centre-Drills



Methods of Forming and Machines Patented

Profitable production tools that insure a big output of uniformly clean, true center holes *at low cost.* Radial relief cutting edges *ground after hardening* retain their cutting qualities for long periods; deep cut spiral chip chutes that cannot clog eliminate tool breakage from this cause.

Accurate center holes insure accurate diameters, reduce wear on the machines, save time in machining and eliminate burned centers—to insure satisfaction use Cogsdrill Centre-Drills.

Catalog 2 Gives Further Details

COGSDILL MFG. CO., Detroit, Michigan

Originators of the Ground Radial Relief Centre-Drill

It made this bridge work right





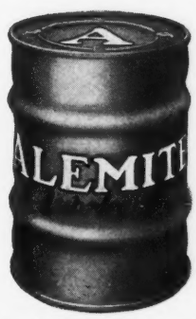
The American Bridge Company built this railroad bridge across the River Rouge at Detroit. Upon completion the lift operation was jerky and irregular. It knocked badly because the erecting engineers were unable to force lubricant over the entire surface of the lift bearings.

So they decided to try Alemite.

Alemite fittings were installed. And the Alemite high pressure system forced lubricant to all the vital bearing surfaces at once. There was a marked improvement immediately—and **E. E. Smith**, Foreman of Erection, writes:

> "A continued application of your (Alemite) lubricant resulted in a continued improvement until the operation was all that could be desired.
>
> "You may rest assured we will recommend your lubricating system when the opportunity presents itself."

For every type of machine from railroad lift bridges to high speed machine tools Alemite lubrication is daily demonstrating its superiority. Our engineers will be pleased to show you how it can be applied to any industrial lubricating problem.



Alemite Lubricant is made specially for high pressure lubrication. It is pure solidified oil. Ordinary greases or oil can be used with the Alemite System, but we know of none that quite equals this special formula. Sold in 100, 200, and 400 pound drums. Also in 5, 1, and ½ pound containers for the hand gun.

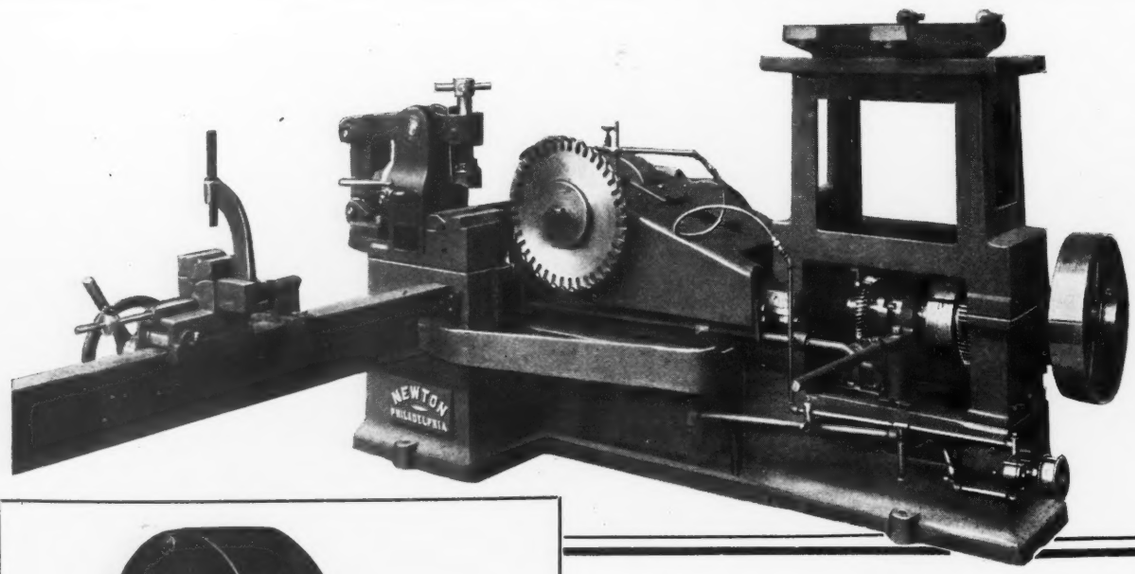
ALEMITE

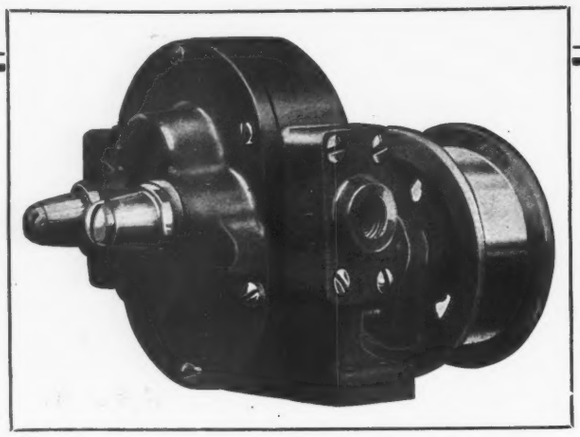
High pressure lubricating system

A Bassick-Alemite Product

THE BASSICK MANUFACTURING CO.

2664 North Crawford Avenue, Chicago, Illinois





Every NEWTON COLD SAW is Furnished with a TRAHERN PUMP

REG. TRADE MARK
REG. U. S. PAT. OFF.

Ask the Consolidated Machine Tool Corporation of America—

Once oracles would have been consulted. Now you ask the man who owns one—the Newton Machine Tool Division of the Consolidated, for example.

This company builds and guarantees to the limit Cold Saw Cutting-off Machines that drive saws up to 84 inches in diameter through solid metal 24 inches thick. This guarantee includes the Trahern Pump equipment, for what would happen to both saw and work without abundant and dependable coolant!

Trahern Coolant Pumps are designed for use on metal working machinery of all kinds; will supply cutting tools with water, oil or compound—in a slow drip or propelled with force to reach the deepest cuts and bores—but always free from pulsation.

Two types, one-way or reversible. Will operate against 100 pounds pressure; run at low speed; deliver 16½ gallons per minute; do not lose their prime.

Ask for bulletin 44.

LEADER-TRAHERN COMPANY

Plants: DECATUR and ROCKFORD, ILL.

NEW YORK CITY
21 East 40th Street

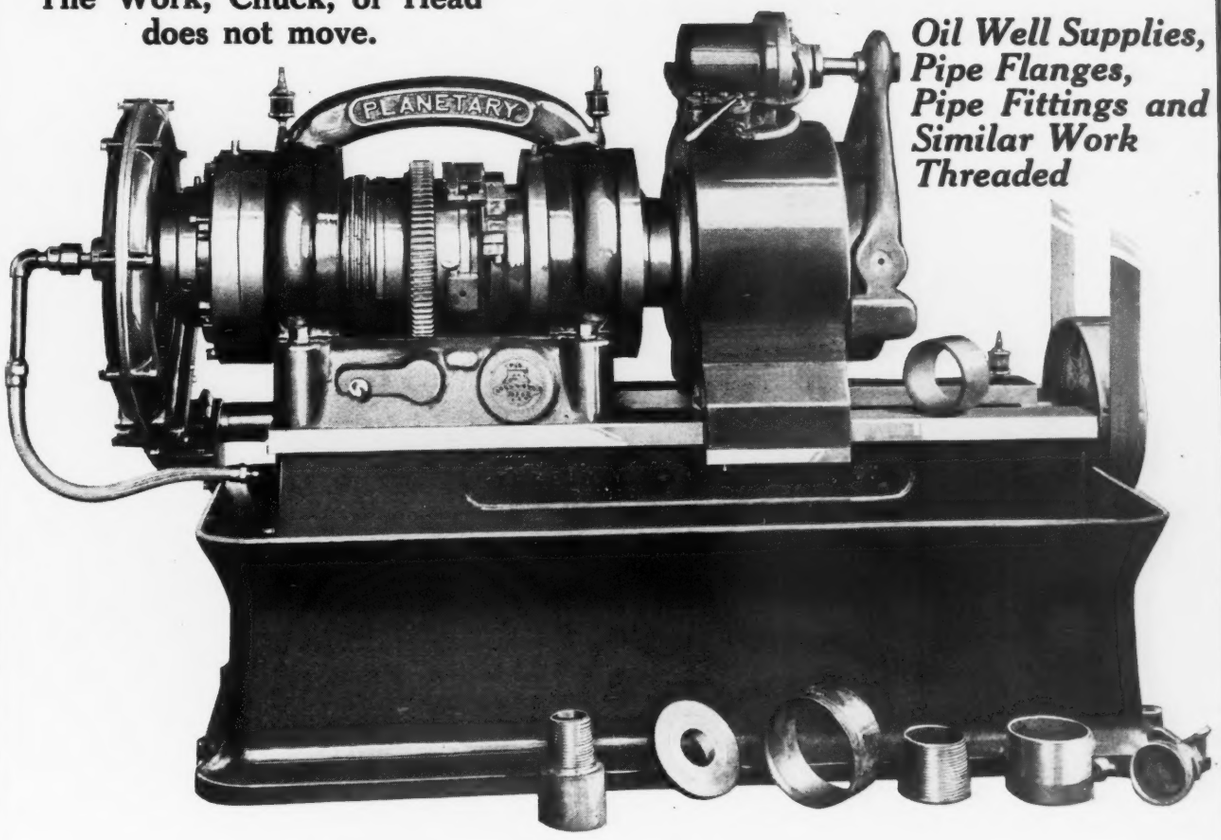
SEATTLE, WASH.
311 L. C. Smith Building

CHICAGO
327 S. LaSalle Street

The Largest and Most Awkward Pieces to Thread are Easy for the

PLANETARY

The Work, Chuck, or Head does not move.



Oil Well Supplies, Pipe Flanges, Pipe Fittings and Similar Work Threaded

6"—3 minutes, floor to floor
8"—4 minutes, floor to floor
10"—5 minutes, floor to floor
12"—6 minutes, floor to floor

A thread milling machine with the basic principles of the perfect machine tool. No sliding ways or gibs of any kind. Smooth, clean cut threads.

Strong, Heavy and Rigid Enough to Continually Hold to the Closest Tolerances. What Kind of Threading Interests You?

THE HALL PLANETARY THREAD MILLING MACHINE COMPANY, Incorporated

Bridesburg, Philadelphia, Penna., U. S. A.

AGENTS:—San Francisco, Eccles & Smith Co. Detroit, J. C. Austerberry. Cleveland, The Cleveland Duplex Mchy. Co., Inc.

THE WELLS CORPORATION

Greenfield, Mass., U. S. A.

A NEW ERA IN PRODUCTION TAPPING

with the

Spiral THREAD WELL Flute

Tap

Patented March 6, 1923



DRAWS OUT CHIPS LIKE A DRILL

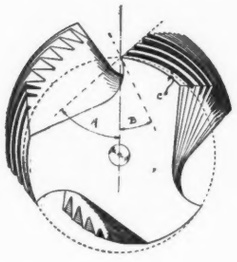


THREE POINTS OF CLEARANCE

A—Rake angle of spiral

B—Rake angle of hook in flute

C—Clearance of eccentric relief



"The Tap with the Drill Flute"

POSITIVE RAKE which "Shears"

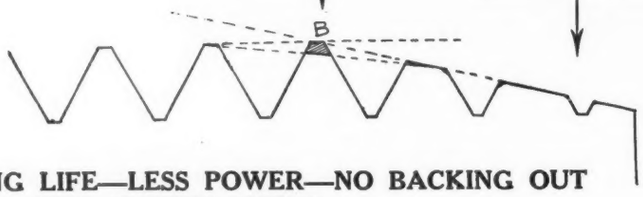
DOUBLE CHAMFER

1 Ground eccentric relief

2 Extra chamfer which distributes heaviest cutting strain over several teeth

EASY STARTING

Catches thread instantly—no "reaming"



EASY STARTING—LONG LIFE—LESS POWER—NO BACKING OUT

IDEAL FOR "BLIND" HOLES

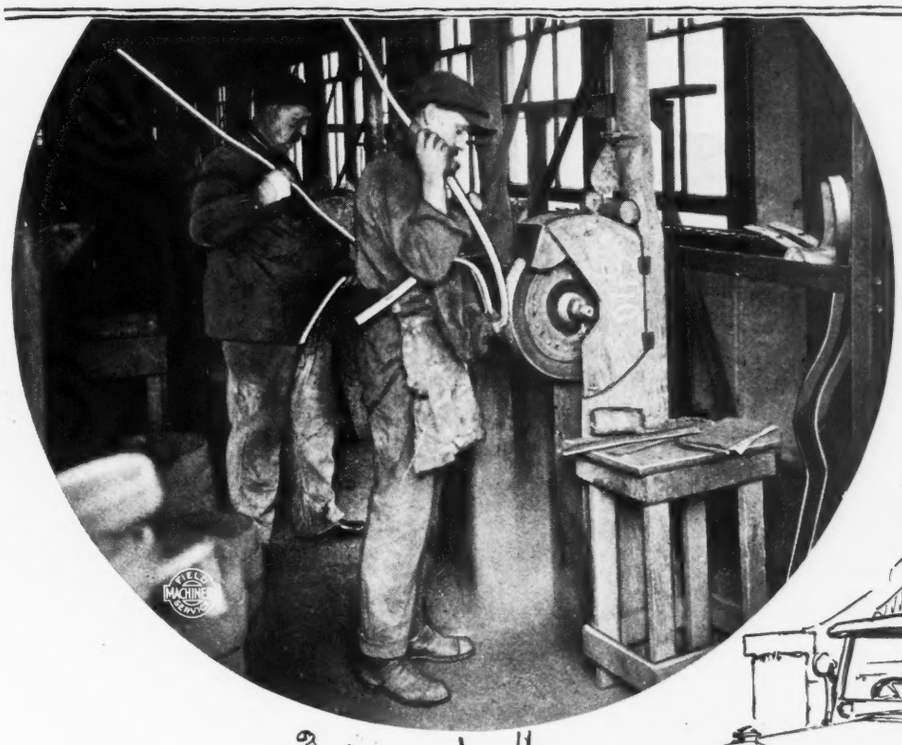
Send for our Catalog No. 1—See Pages 21-24—Also Other New Tools

THE WELLS CORPORATION

Greenfield, Mass., U. S. A.

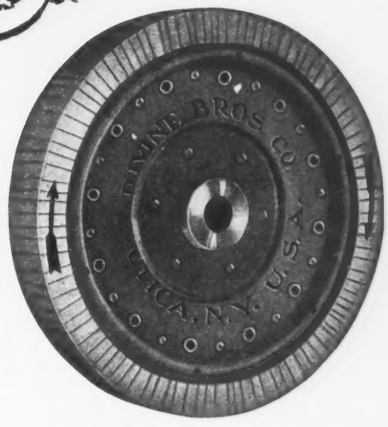
M-8-23

DIVINE POLISHING SERVICE



Making a Decoration out of a Utility

Nickel finish gives style to automobile bumpers, gives them greater sales value. It costs a little extra to polish the bars and nickel them—but it is worth it. Lyons Bumpers are finished this way. Divine Polishing Service assisted in planning the methods used; Divine Polishing Wheels do the actual work. The operations are grind, polish, plate and buff. On the polishing operation an operator will finish 200 to 225 bumpers per day.



A correctly planned and equipped polishing room will help you gain in production, economy, efficiency and profit. Let us show you.

ENGINEERING DEPARTMENT

DIVINE BROTHERS COMPANY

Utica, New York, U. S. A.

Just What Automobile and Tool Builders Have Always Needed

Second operation jobs on odd-shaped parts furnish an ever present problem, often entailing expensive fixtures and tool changes.

This recent adaptation of a well established machine solves a host of these difficulties; provides for the performance of three successive operations with a common center in any odd-shaped parts within its capacity—fast, accurately and economically.

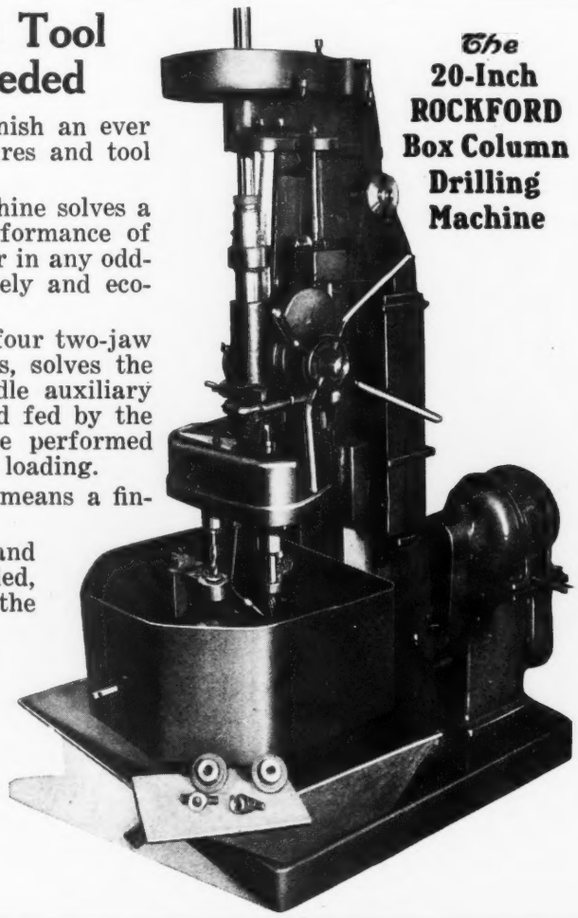
A rotary station indexing table, equipped with four two-jaw chucks provided with special work-holding jaws, solves the feeding and fixture problem; and a three-spindle auxiliary head, carried on the table ways, but driven and fed by the spindle, permits three tooling operations to be performed simultaneously and leaves one position open for loading.

Indexing is the only idle time and every index means a finished part.

Output? Excellent! The accompanying yoke and flange members, for example, are rough drilled, taper reamed, faced and finish taper reamed at the rate of 250 pieces per 10-hour day.

THE ROCKFORD DRILLING MACHINE Co. • ROCKFORD • ILL., U.S.A.

Let us tell you *more about it.*

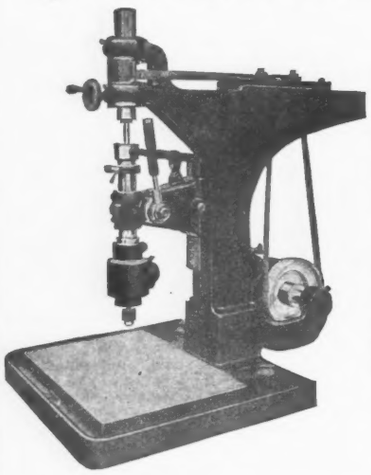


The **20-Inch ROCKFORD Box Column Drilling Machine**

Like all our other products

Avey

TAPPING ATTACHMENTS give the best of satisfaction



Six sizes to give maximum results from 0 to 13/16" in cast iron.

Our Bulletin C.B. 2 tells all about the High Speed and the General Purpose Attachments.

Let us help you solve your tapping problems

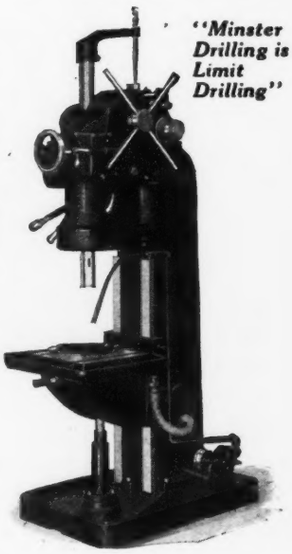
The Avey Drilling Machine Company
CINCINNATI, OHIO

Minster Hi-Duty Drills

Profitable equipment for shops specializing in big work. Have wide range, plenty of power and every operating convenience for big production on wide variety of work.

Five sizes from 1½" to 3¼" in solid steel.

Ask for the catalog which describes them fully.



"Minster Drilling is Limit Drilling"

The Minster Machine Co.
MINSTER **OHIO, U. S. A.**

H O L E S

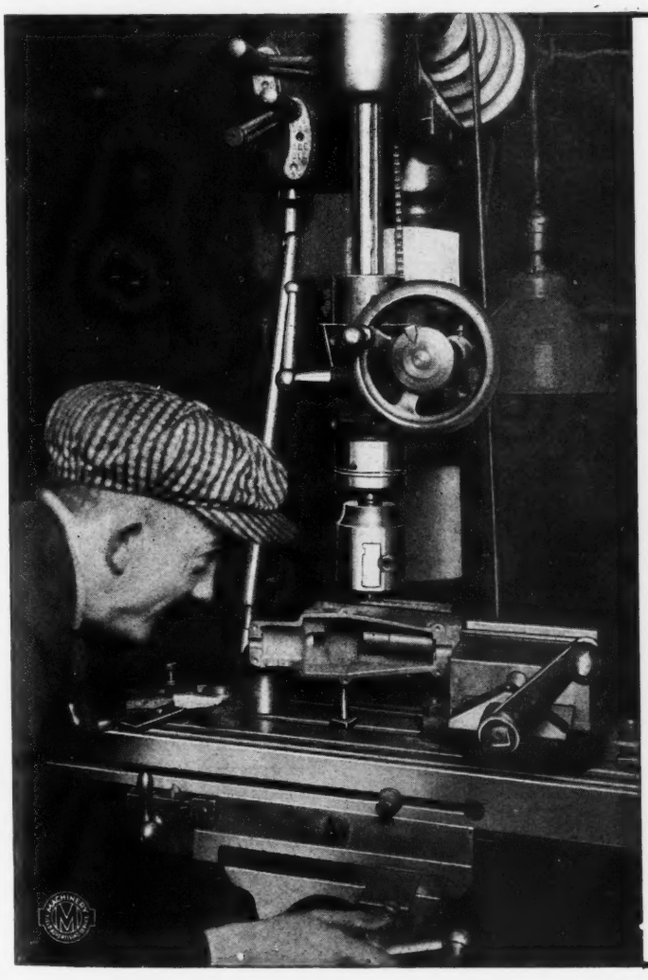
drilled with speed and utmost accuracy when you have—

HARRINGTON

Multiple Spindle Drills

made by

Edwin Harrington, Son & Co., Inc.
Philadelphia, Pa.



An Unusual Machine for Unusual Work

In an experimental shop, the Knight Milling and Drilling Machine is more than ordinarily useful—its tilting table makes it the equivalent of several machines.

In the manufacturing department the Knight more than holds its own. You could not find a better machine for rapid and accurate production of duplicate parts —for milling and drilling at angles.

The illustration shows one of the four "Knights" at the Davis-Bournonville Company plant, Jersey City, N. J. This one is finishing slots 3/16" wide, in a cast-iron gear guard while micrometers on slide and table locate the cutter and determine the length of slot. All four machines in this plant handle a great variety of unusual work and are greatly appreciated.

Write for Knight details

W. B. Knight Machinery Co.
3920 W. Pine St. St. Louis, Mo., U. S. A.

FOREIGN AGENTS—The Coats Machine Tool Co., Ltd., London, Eng.; Yamatake Company, Tokyo, Japan; Allied Machinery Co. of America, France, Spain, Portugal, Italy, Switzerland, Begium.

Could You Equal These Drilling Records?

Piece Number	Remarks	Size of Hole	Depth of Hole	Material	Pieces Per Hour
1	One hole	1/8	5/8	C. R. Steel	900
2	Six holes to center of head	1/8	7/8	C. R. Steel	150
3	One hole at a time	1/8	7/8	C. R. Steel	450
4	One hole at a time	3/16	1	Seamless Tubing	450



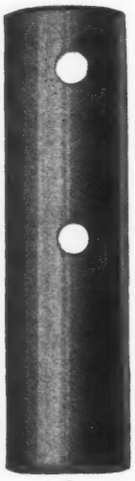
1



2



3



4

RESULTS LIKE THESE

would only be possible on a machine that operates continuously with no non-productive time to be charged against the job.

We also build the Detroit Continuous Production Centerless Grinder.

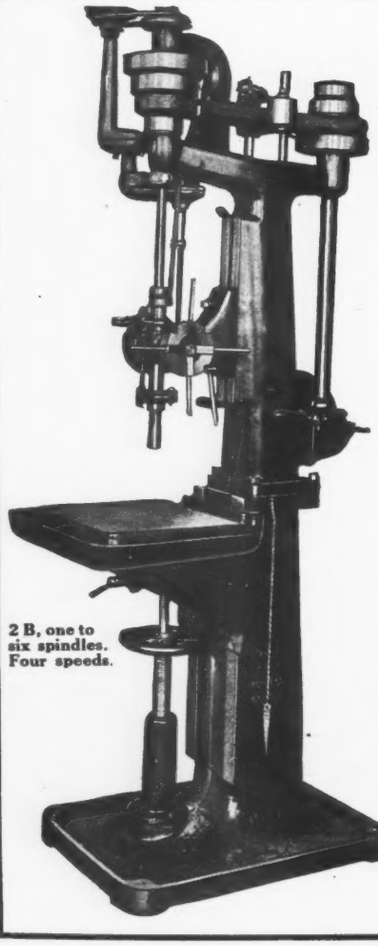
On the Detroit 5-Spindle Semi-Automatic Drilling Machine, all five drills are fed to the work and returned in an uninterrupted sequence of movements.

The operator is merely required to load and unload the fixtures; and their quick acting mechanism enables him to set up work for all five spindles.

It's eliminating the non-productive time that counts.

May we quote on your blueprints or samples?

DETROIT MACHINE TOOL COMPANY
DETROIT 6525 St. Antoine St. MICH.



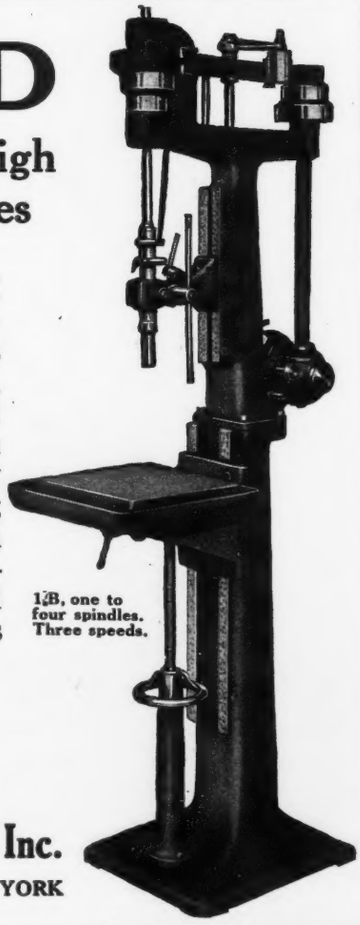
2 B, one to six spindles. Four speeds.

EDLUND

Ball Bearing, Sensitive, High Speed, Drilling Machines

Ten ball bearings per spindle; speed changes made from natural working position, without stopping machine; straight, endless belt drive; belt shifted by rack and pinion and from either side; spindle carefully balanced and counterbalanced; adjustable depth screw; splash system of lubrication; provision for taking up all slack and wear; pump, tank and fittings if desired.

Builders of Portable Bench Hack Saws and Semi-Automatic Drilling Machines for all purposes.



1½B, one to four spindles. Three speeds.

Edlund Machinery Company, Inc.
CORTLAND NEW YORK

In Morris Radials You Get Power and Convenience

In the Morris Radial the head is heavily constructed, correctly balanced and travels freely on the arm's broad ways by means of a rack and pinion—controlled through reduction gears by a handwheel within easy reach at its highest position—and is locked by two screws, clamped simultaneously by one handle.

Spindle gears are helical—providing more than one tooth in mesh at the same time—and all the back gears and back gear clutches are of chrome nickel steel, important features in securing the smooth, quiet, powerful force for which these machines are famous.

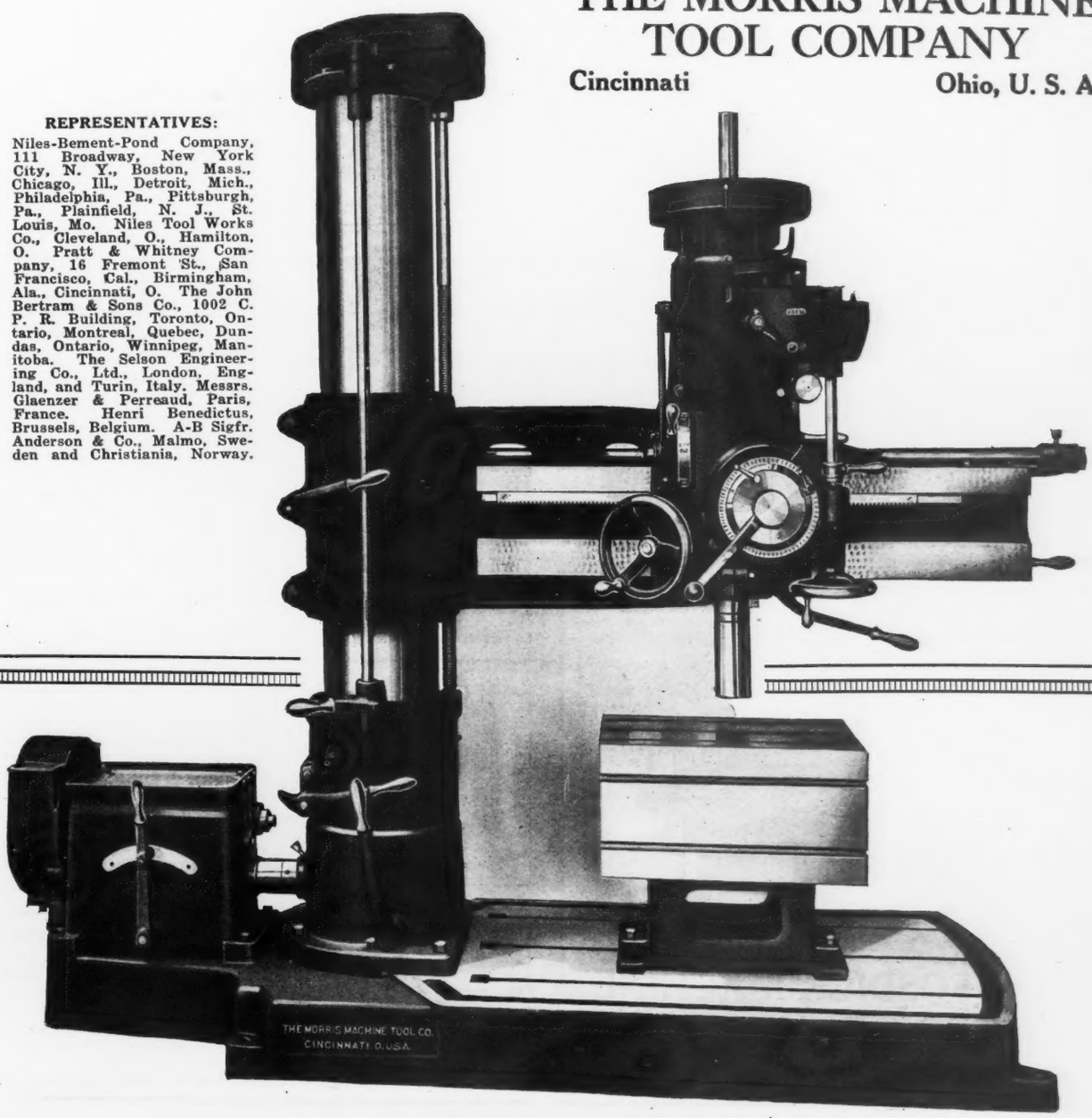
The "Morris" head has other advantages and the column, arm, base and speed box have still more—equally interesting, equally important and fully described in the circulars which show the whole line of 2, 2½, 3, 3½, 4 and 4½ foot machines.

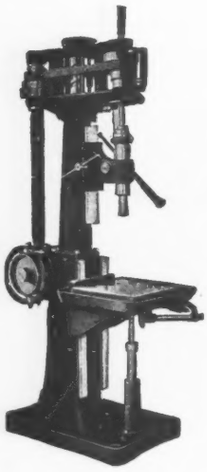
THE MORRIS MACHINE TOOL COMPANY

Cincinnati **Ohio, U. S. A.**

REPRESENTATIVES:

Niles-Bement-Pond Company, 111 Broadway, New York City, N. Y., Boston, Mass., Chicago, Ill., Detroit, Mich., Philadelphia, Pa., Pittsburgh, Pa., Plainfield, N. J., St. Louis, Mo. Niles Tool Works Co., Cleveland, O., Hamilton, O. Pratt & Whitney Company, 16 Fremont St., San Francisco, Cal., Birmingham, Ala., Cincinnati, O. The John Bertram & Sons Co., 1002 C. P. R. Building, Toronto, Ontario, Montreal, Quebec, Dundas, Ontario, Winnipeg, Manitoba. The Selson Engineering Co., Ltd., London, England, and Turin, Italy. Messrs. Glaenzer & Perreaud, Paris, France. Henri Benedictus, Brussels, Belgium. A-B Sigfr. Anderson & Co., Malmo, Sweden and Christiania, Norway.





How the Fosdick Family Grew

A concern using Fosdick Radial Drilling Machines needed an Upright Drill—but they were so solidly "sold" on Fosdick quality that it *had* to be a Fosdick machine.

So we brought out the Fosdick Upright.

Later, other manufacturers called for further variations of the Fosdick models—and we designed the Fosdick Ball Bearing Sensitive Drill.

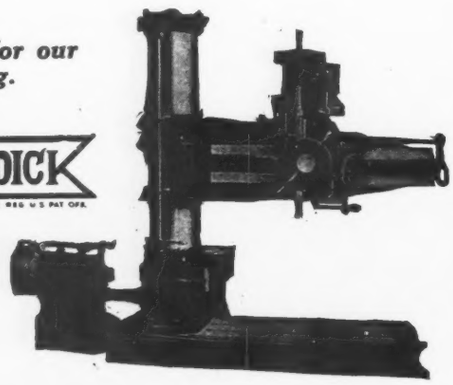
The several sizes in which each style drill is built make the Fosdick family large—but each unit in the line embodies the Fosdick standard of excellence and represents developments far in advance of general practice.

Radial Sizes—2′ to 6′; High Speed Sensitive, 3′ 3½′, 4′; Balanced arm, 4′, 5′, 6′.

Upright Drills—21″ to 30″ swing.

Ball Bearing—Superspeed Sensitive, 1 to 8 spindles, 13″ to 24″ swing.

Send for our catalog.

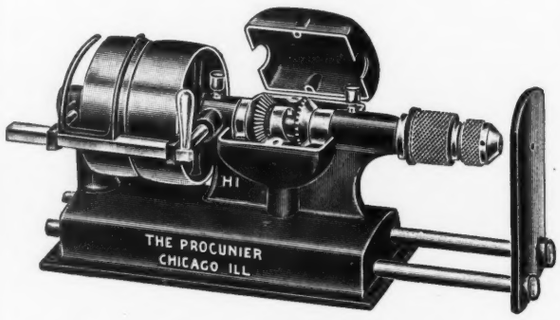


FOSDICK

THE FOSDICK MACHINE TOOL COMPANY

CINCINNATI, OHIO, U. S. A.

The "Procunier"



A New Bench Tapping Machine Designed by Tapping Experts

The "Procunier" reputation for efficient tap holding devices and tapping attachments makes this new machine worth noticing. It is built for service. All bearings are of bronze. Simple in construction and having the new and improved driving and reversing mechanism. The "DOUBLE-JAW" chuck, plus the Safety Friction, which slips the instant the tap hits bottom, eliminates tap breakage.

If you do any tapping, get the details of this new machine.

WILLIAM L. PROCUNIER

18 So. Clinton Street CHICAGO, ILL.

The Mueller Radial

Reduces Drilling Costs

Because its unique one-piece column construction and extra long arm-bearing provide more than ordinary power and rigidity; and the convenient centralization of *all* controls within reach of working position saves time and effort.

"It's a Leader"

The Mueller Machine Tool Co.

RADIAL DRILLS AND LATHES

CINCINNATI Established 1902 OHIO, U.S.A.



One Set-Up, Then Uninterrupted Operation

P&H Boring, Drilling & Milling Machines

Give Maximum Production—Accuracy

PAWLING & HARNISCHFEGER CO.

MILWAUKEE, WIS.

HOEFER

Branches in Principal Cities

"Minute-Savers"

Speed the coming of better business to you

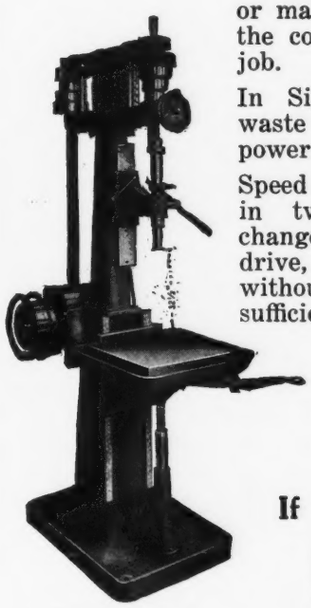
HOEFER DRILLERS *and* **AUXILIARY HEADS** by their time saving features make possible an economy in drilling operations that increases your margin of profit considerably.

Adopt Hoefer better drilling methods without delay. Catalog?

THE HOEFER MFG. CO., Freeport, Ill.

Sipp Sensitive Drill Presses

Stop Waste—Bring Prices Down



Each unit of time, power or material lost adds to the cost of the finished job.

In Sipp Drill Presses waste motion, time and power are eliminated.

Speed changes are made in two seconds, belt changes in ten; direct drive, smooth, even and without power waste; sufficient weight, careful balance and ample power insure accuracy—eliminate loss of material—even at highest speeds.

Get the details

If ITS TRADE A MARK SIPP It's Right

THE SIPP MACHINE CO.
PATERSON, N. J.

Francis Reed Co.

Sensitive Drilling Machines

Send for catalogue

43 Hammond St., Worcester, Mass.



The Lindgren 20" High Speed All Geared Drill

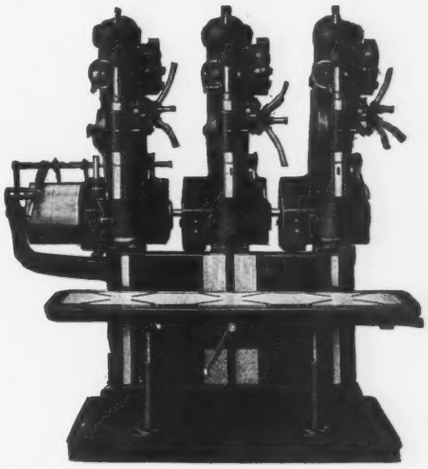
A powerful machine with back gear, also tapping attachment which can be operated either by hand or foot. Self-oiled with new lubrication features, no leakage of oil. Positive gear feed. Ten speeds with back gear, five without.

Write for descriptive Circular

Mechanics Tool Company
ROCKFORD ILLINOIS, U.S.A.

For Fast Production, Use Our

SELF-OILING ALL GEARED BOX COLUMN GANG



Mechanically perfect. Wonderful productive capacity. All gears and their bearings fully enclosed, and automatically and continuously oiled. Each spindle has eight geared speeds and eight geared feeds, all independent and all under instant control of operator from front of machine. No slipping, troublesome, time-wasting, expensive cone belts. Every movement positive and result producing. The 20" machine here shown drives ¾" to 1¼" high-speed drills to their working capacity. In actual use has multiplied output over 1400 per cent! It pays to use the **ALL GEARED SELF-OILER.**

Write for Catalog "M"

BARNES DRILL CO., Inc., 1907
814 Chestnut St., Rockford, Ill., U. S. A.

Agents for Great Britain: Burton, Griffiths & Co., Ltd., London, E. C. **Belgium:** G. & F. Limbourg Freres, Brussels. **France:** R. S. Stokvis & Fils, Paris. **Japan:** Roku-Roku Shoten, Tokyo. **Italy:** Alfred Herbert, Ltd., Milan. **Spain and Portugal:** American Machinery Corporation, S. A. C., Madrid. Sindicato de Maquinaria Americana, Bilbao. **New South Wales:** R. L. Scrutton & Co., Sydney.

Sibley Drilling Machines

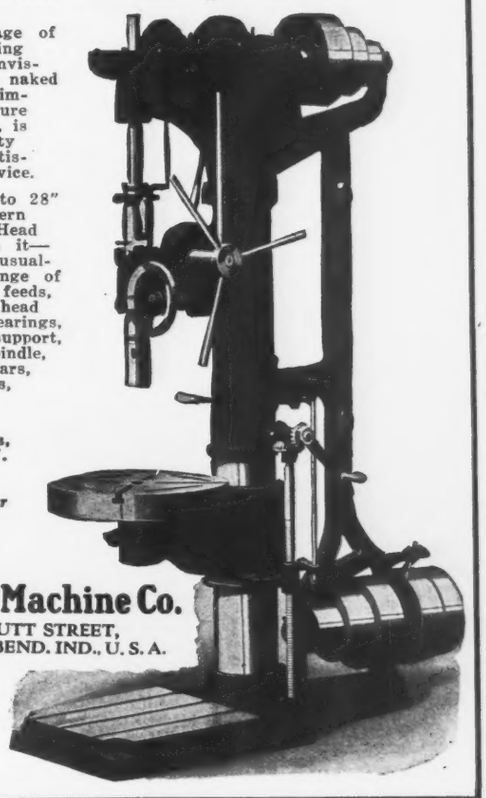
Built for Long Service

An advantage of Sibley Drilling Machines, invisible to the naked eye but an important feature nevertheless, is their capacity for long, satisfactory service.

These 24" to 28" Heavy Pattern Stationary Head Drills have it—likewise unusually wide range of speeds and feeds, extra long head and arm bearings, firm table support, balanced spindle, enclosed gears, wide pulleys, etc.

Other types, 16" to 30".

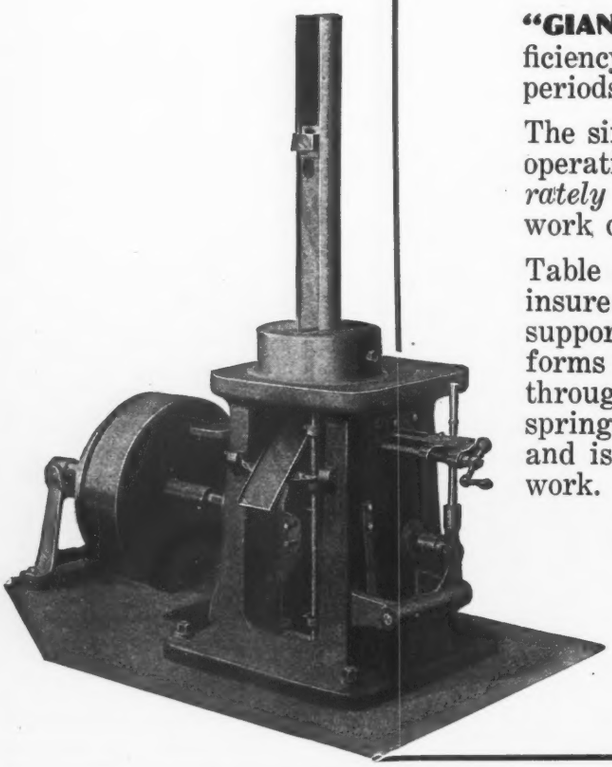
Write for Details



Sibley Machine Co.
8 TUTT STREET,
SOUTH BEND. IND., U. S. A.

Satisfactory Keyseating!

What Does It Mean to You?



"GIANT" Keyseaters maintain high efficiency in constant operation over long periods, *without repairs.*

The simplicity of these machines and their operating principle enables them to *accurately* cut straight or taper keyways on work of all sizes.

Table and column are cast in one piece to insure rigidity; the work set up on the post supports itself by its hub; the same post forms a guide for the tool bar supporting it through its entire length and preventing spring. The stroke can be set to any length and is easily changed for single operation work.

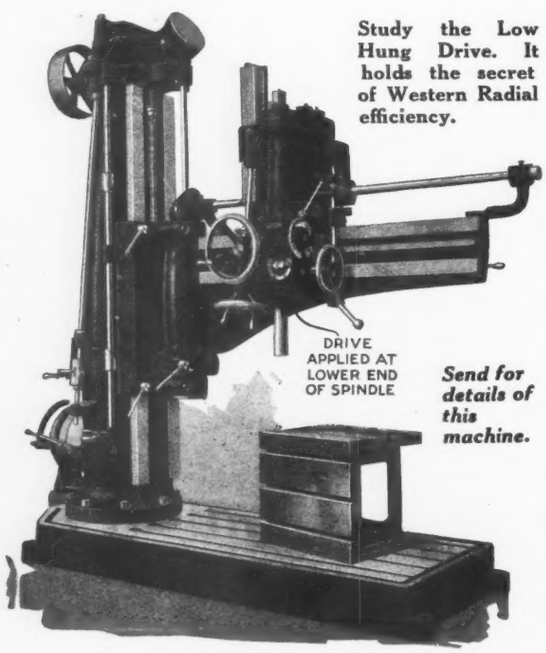
A serviceable, *profitable* machine made in 8 sizes. Let us tell you more about it.

MITTS & MERRILL
843 Water Street Saginaw, Mich.

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Christiania, Norway and Stockholm, Sweden.

For Heavy Drilling

Ample power and sturdy construction make Western Radial Drills particularly efficient in heavy drilling operations.



Study the Low Hung Drive. It holds the secret of Western Radial efficiency.

Send for details of this machine.

WESTERN MACHINE TOOL WORKS
HOLLAND, MICH., U. S. A.

Portable Power Keyway Cutter



BEST portable machine made for **cutting keyways in shafts.** Clamps to shaft and attaches to nearest light socket. Cuts accurate keyways quickly of any standard size and length—at very low cost. We also furnish hand-operated machines.

Write today for Literature and Prices.

THE BUCHER-SMITH CO., East Liverpool, Ohio
SPECIAL MACHINERY BUILT TO BLUEPRINTS

CUT KEYSEATS ANYWHERE
Quickly—Accurately—Economically

Burr Portable Shaft Keyseater saves the time and trouble of setting up or moving machines; works accurately in any position; mills keyseats 12" long with one setting in shafts to 5" diameter. Hand or motor drive. Write for particulars.

JOHN T. BURR & SON, 432 KENT AVENUE BROOKLYN, N. Y.
"When you buy the Burr you buy the best"

LAPOINTE KNOWS!

Broaching efficiency means profitable production. Put your broaching problems up to men who know.

Send for a catalog of Lapointe Broaching Machines and Broaches.

The Lapointe Machine Tool Company
HUDSON, MASS., U. S. A.



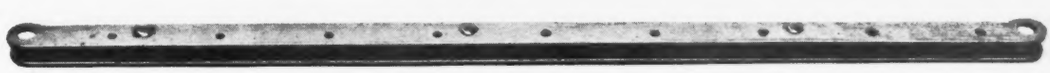
GRANT

Tight rivets that will not work loose; loose rivets that do not bind. For "Rivets that hold" get details of Grant Riveting Machines.

1200 Rivets per Hour!

There are three rivets in each bar, nine bars in each adding machine made by this company. So the operator completes the bars for an average of 44½ machines in an hour—every hour.

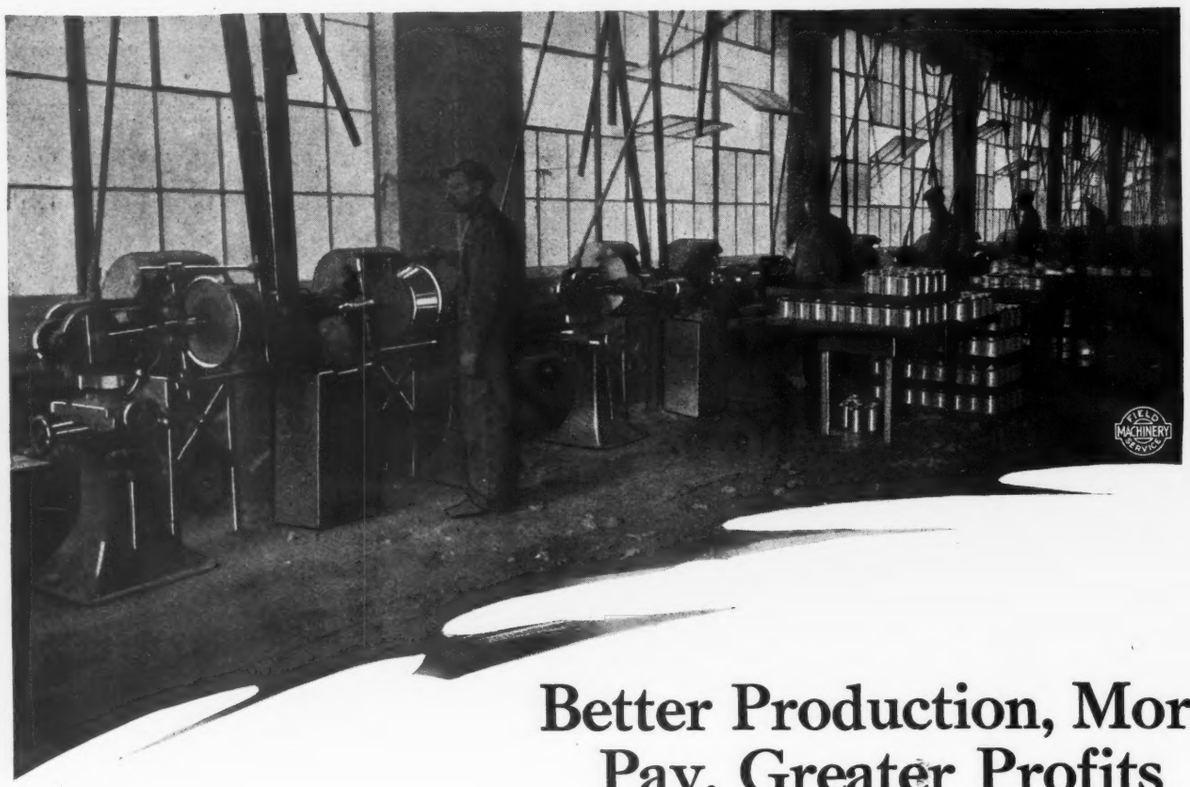
The result is accurate, the finish excellent. Good production, low operating costs, practically no repairs, make Grant Riveters extremely profitable. Made in sizes to handle all classes of work and for spinning tight or loose rivets.



GRANT MANUFACTURING & MACHINE CO.

N. W. Station, Bridgeport, Conn.

Automatic Buffing Machines



Better Production, More Pay, Greater Profits

There's a double story to the installation of Automatic Buffing Machines by the Illinois Pure Aluminum Company, Lemont, Ill.—an interesting story of modern methods and profitable results.

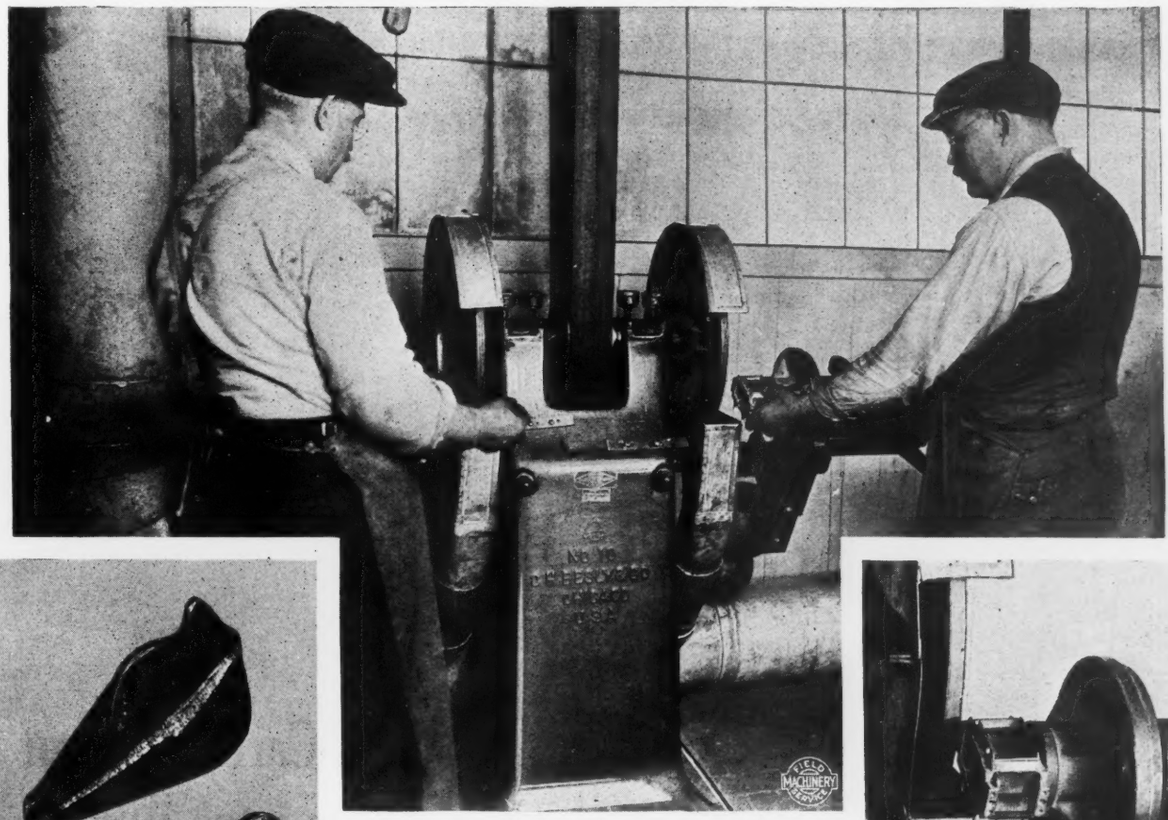
Three years ago a new factory manager dug out and set up a pair of old style Automatic Buffing Machines (unused because of prejudice) and immediately jumped the production of their 15″ kettle from 275 to 1000 in 10 hours, one operator. The installation of a dozen "Automatics" which followed not only jumped production on all work but put it on a stable basis.

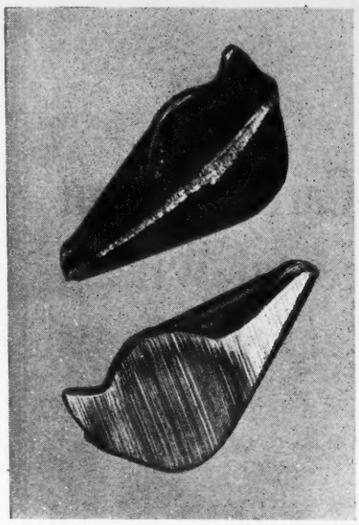
About a year ago when added equipment was needed some new Type H Machines were tried out. Production was increased again, from 10% by the single spindle machine to 25% by the double spindle type. The operators of the old style machines (on piece work) kicked strenuously—*they all wanted new machines.*

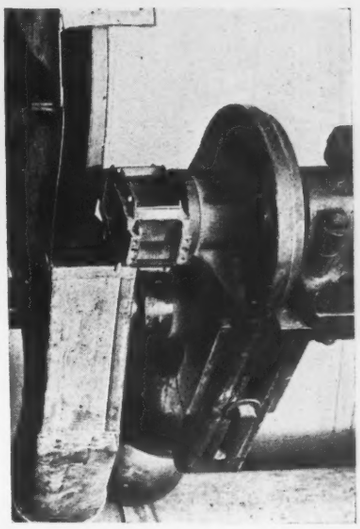
The result—with a progressive manager—was obvious. All the old type Automatic Buffing Machines were sold and Type H Machines were installed throughout. There are now 36 in operation with space reserved for more to come. The last order was for a car load; 22 machines in one shipment. If you polish any work that may be chucked—investigate these machines. They are simple, practical and easily operated—and the investment is not so high as the increased profits would seem to indicate.

THE AUTOMATIC BUFFING MACHINE COMPANY

BUFFALO, N. Y., U. S. A.







Excellent Output at Both Ends of this

BESLY DISC GRINDER

The Webster Electric Company, of Racine, Wisconsin, has placed several reorders for Besly No. 10 Double End Grinders during the past six years.

At the left, cast iron push fingers are being ground on both sides to ½" thick. They are held in one of the simple fixtures characteristic of Besly production. Production averages 290 pieces per hour.

The operator at the right is grinding die oscillator frames on both sides. These pieces have a 2" hole through them and are located on a stub arbor against a stop. About .004" to .005" of stock is removed from both sides at the rate of 200 pieces per hour.

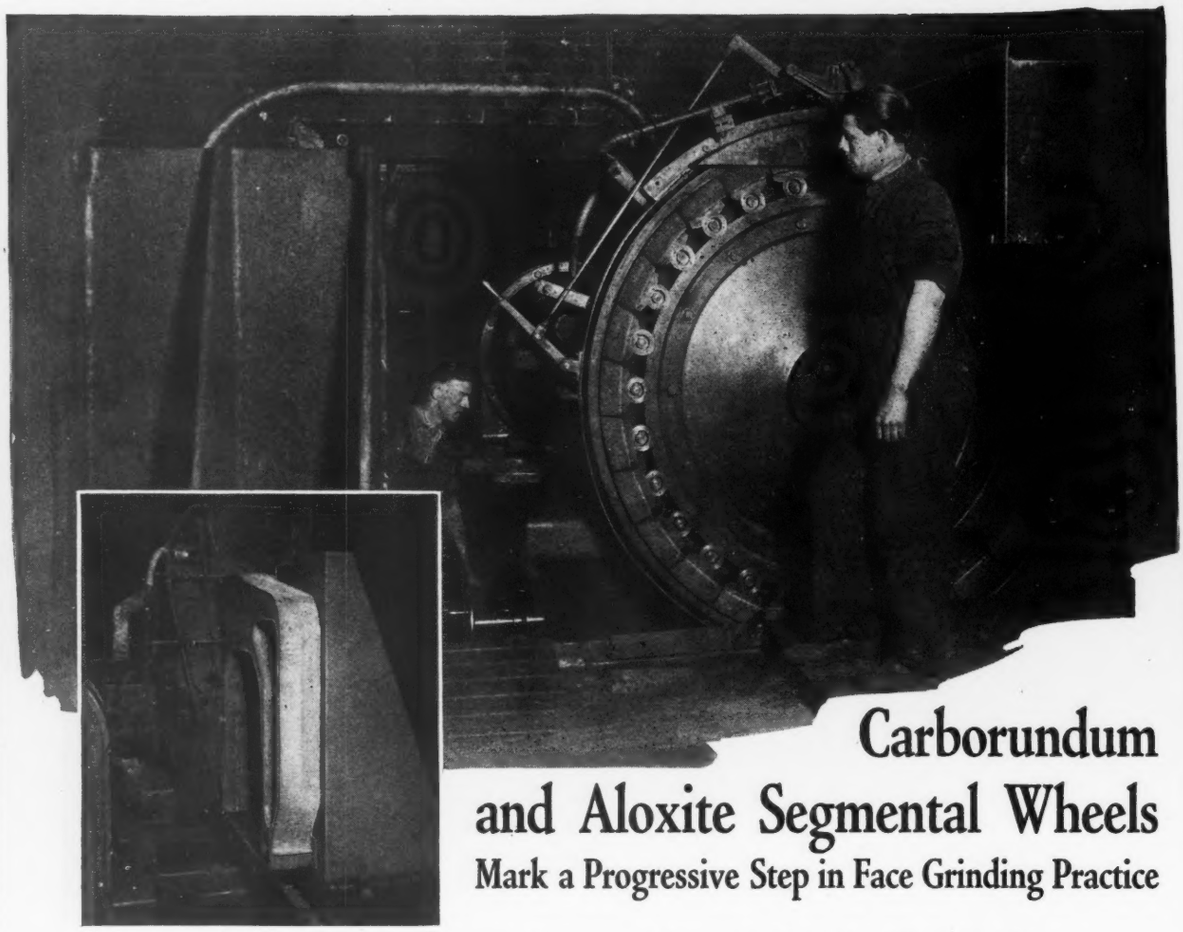
Besly Grinders are economical and durable, fast and accurate.

BESLY CHICAGO

Let us mail to you our catalog describing the whole line.

CHARLES H. BESLY & COMPANY

120-B. No. Clinton St., Chicago, Illinois



Carborundum and Aloxite Segmental Wheels

Mark a Progressive Step in Face Grinding Practice

MANY of the jobs of surface grinding on machines such as the Diamond Heavy-Duty Face Grinder are now being done with Carborundum or Aloxite Segmental Wheels, made up of abrasive segments or blocks.

These segmental wheels are particularly effective on big work where comparatively large amounts of stock are to be removed and where production is an all-important factor. The blocks have a shear-cutting action and a more definite clearance than is provided by the solid wheel, therefore they cut fast, clean and cool.

Then, too, there is the economy of their long life to consider. Segmental wheels can be made in 30-, 36-, 54- and 66-inch diameters—the blocks in all standard grits and grades to meet many classes of work.

The illustration shows a 66-inch segmental wheel on a Diamond machine. It is the biggest wheel of its kind ever made and it is used at the U. S. Radiator Corporation Detroit plant for grinding heating boiler sections.

The sections are approximately 5½ feet wide and 4½ feet high. The operation consists of grinding the bearing surfaces of the sections so as to insure a tight joint. From 1/16 to 3/8 inch of stock is removed depending upon the condition of the casting. Four passes across the wheel and the casting is ground clean and true and it takes two minutes to grind one side.

The Carborundum Sales Engineering Department would be glad to give you every possible help in increasing your grinding production and promoting grinding economy by the segmental wheel method

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y., U. S. A.

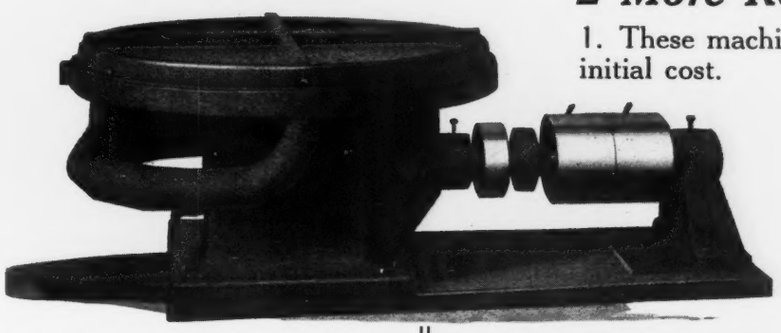
New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Grand Rapids, Milwaukee
The Carborundum Company, Limited, Niagara Falls, Ont.

Real Production Tools—

that's one reason why

GARDNER DISC GRINDERS

upon adaptable flat surfaces, will effect great economies over other methods of finishing.



2 More Reasons Are:

1. These machines are relatively inexpensive in initial cost.

2. They're extremely economical to operate, because of our heavy-type G. I. A. Disc, which cuts disc expense to the minimum.

Find Out What GARDNER-GRINDING Can Do On YOUR Flat Surfaces!

Write for Our Operation Folder giving bona-fide production data!

Gardner Machine Company

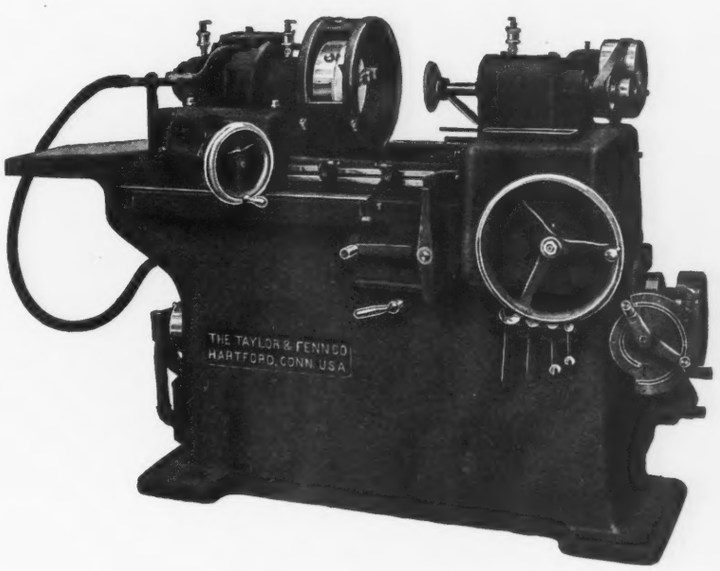
414 East Gardner St., Beloit, Wisc., U. S. A.

For Accurate Bore Grinding

The efficiency of the unique design of the Taylor & Fenn Bore Grinder is shown in the excellent results it gets.

The wheel spindle head and intermediate pulley supports are integral, firmly screwed to the base and without movable parts. The substantially built work-head and table move on a large V and lubricated flat ways protected from water and grit. Design and construction insure rigidity and permit high speeds on heavy grinding.

Massive, compact and self-contained the Taylor & Fenn Bore Grinder grinds round, straight holes to 8″ diameter, 8″ deep at minimum cost.



Let us send you details

THE TAYLOR & FENN COMPANY, Hartford, Conn., U.S.A.

VITRIFIED WHEELS

VITRIFIED

There's a grade, grain and style for every machine, each class of work. Grinding Wheel experts are ready to help you in the selection, and advise you in the use of the wheel you buy. Our carefully developed recording system guarantees perfect duplication whenever you reorder.

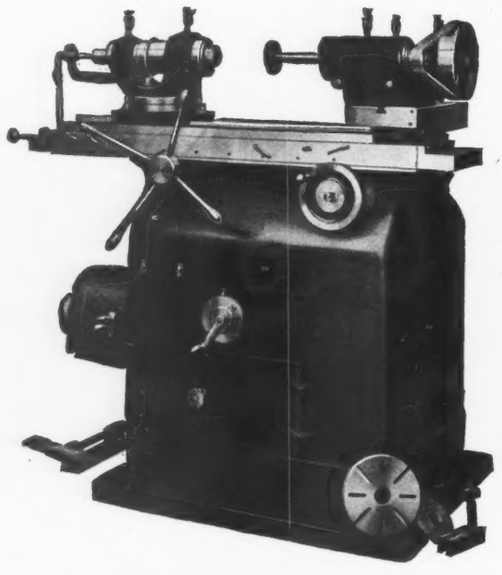


Vitrified users are regular customers. Send for a catalog of Vitrified Wheels.

VITRIFIED WHEEL COMPANY, Westfield, Mass., U.S.A.

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"



Specify The Rivett No. 106 Internal for tool-room

TOOL-ROOM INTERNAL GRINDER

Time can be saved in the TOOL-ROOM as well as in the production departments. Selection of the proper machine is important.

An Internal Grinder for TOOL-ROOM use must be:

Quickly set up for the difficult job. Big enough for the larger work. Refined enough for the smaller work. Adaptable to the unusual. Rugged enough to last.

The Rivett No. 106 is all this.

Dealers in all the principal cities. Write to them or direct to us.

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"

Rivett Lathe and Grinder Corporation

Brighton District of Boston, Mass., U. S. A.

"RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY" "RIVETT QUALITY"

Borolon
TRADE MARK

and

Electrolon
TRADE MARK

GRINDING WHEELS





TRADE ABRASIVE MARK REGISTERED

Worn Down 50% but Still on the Job

This grinding wheel was 24″ in diameter when it was put to work. The diameter is 12″ now and it will probably be kept on the job until it's down near the flanges, when a new one just like it will take its place.

Grain 20, Grade R Borolon gives excellent service in grinding mining tools of the kind shown in photo. This wheel stands up well under difficult conditions without frequent dressings to keep it in condition.

They have used "Abrasive" Grinding Wheels of various grains and grades for some years in this mine tool shop—always with satisfaction; they tell us what they wish to grind—our engineers see that they get the "right wheel for the job." This insures the invariable efficiency of "Abrasive" Grinding Wheels.

The new "Abrasive" booklet is just off the press. Write for it.

ABRASIVE COMPANY

Bridesburg, Philadelphia, U.S.A.

566 W. Washington Blvd., Chicago



For Fine Finishing

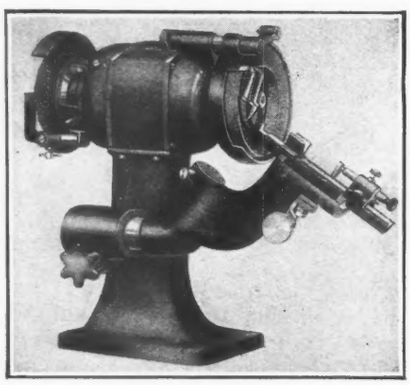
This Abrasive Surface Grinder, shown finishing a lamination die for a Ritter Dental Lathe (Ritter Dental Manufacturing Co., Rochester, New York) is used for all the finish grinding operations in the manufacture of these delicate machines. So much for accuracy! Operating conveniences make it an equally efficient production grinder—a machine that is profitable wherever it is used.

Let us tell you more about Abrasive Grinding Machines.

Abrasive Machine Tool Company

East Providence Rhode Island

Drills Ground on this Machine Cut Faster—Stay Sharp Longer Than Hand Ground Drills



In addition to this you can reduce drill breakage to a minimum by the installation of this machine. There is a Grand Rapids Drill Grinder particularly adapted to your requirements.

Get your Grinder Book today; it's free.

Gallmeyer & Livingston Co.

Successors to

G. R. Grinding Machine Co., Valley City Machine Co.
344 Straight Ave., S. W., Grand Rapids, Michigan

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT

Builders of

Hole Grinders
Hole and Face Grinders
Deep Hole Grinders

Reg. U. S. Pat. Off.

THOMPSON

UNIVERSAL GRINDING MACHINES

SEND FOR BULLETIN No. U-13

THE THOMPSON GRINDER CO.

SPRINGFIELD - - - - OHIO

Grinding and Polishing Machinery

Diamond Machine Co.

Providence, R.I., U.S.A.

"PRODUCTION"
POLISHING AND FINISHING
MACHINES

For Quickly and Efficiently Finishing Cylindrical Parts in Metal, Rubber, Fibre and other Hard Composition Materials.

The centerless feed mechanism insures high speed production with a minimum expenditure of labor. The unique design and accurate construction insure mechanically uniform results. Send us a sample of work—any size to 4″ diameter; time studies and production estimates will interest you.



TYPE A

Send for a circular.

PRODUCTION MACHINE CO.

GREENFIELD MASSACHUSETTS, U. S. A.

Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Cincinnati. Roland Anderson, 40 Lawrence Ave., Detroit, Mich. Marshall & Huschart Machinery Co., Chicago, Milwaukee. Allied Machinery Co. of America, New York City, N. Y. (Export.)

William Sellers & Co. Incorporated

Established 1848

PHILADELPHIA, PA.

LABOR SAVING MACHINE TOOLS

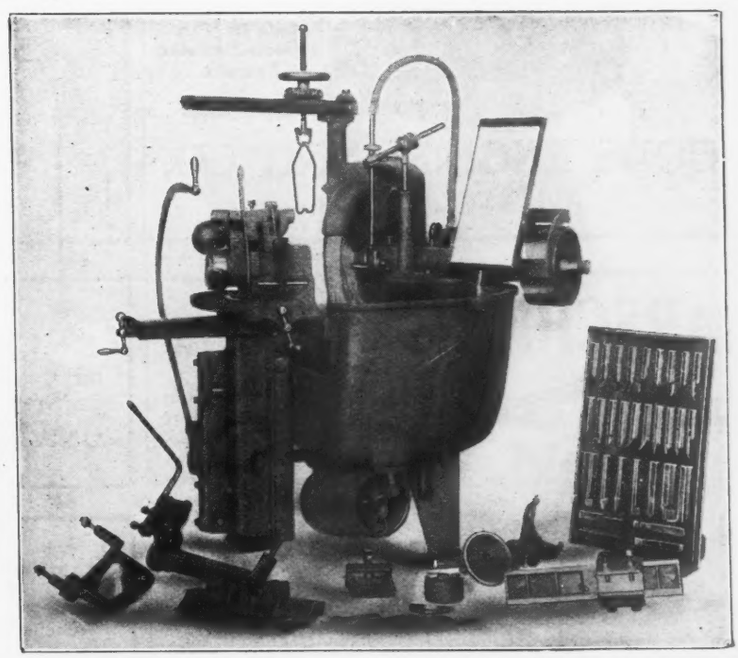
The Sellers Tool Grinder

for quickly, correctly and economically forming and sharpening (with one chucking) cutting tools for Lathes, Planers, Slotters, etc., is without an equal. It produces and duplicates shapes and angles at a surprising saving over any other method.

Large Output
Accurate Work
Low Cost of Maintenance

are three of the reasons why users of this machine find it so profitable that it is regarded as indispensable wherever installed. Tools ground and shaped by it do much more work before regrinding than when sharpened in any other way.

It Saves Time
It Saves Money



SHAFTING—INJECTORS—DRILL GRINDING MACHINES

Proof of the Pudding

"I am in need of some Emery Wheels. I have been a user of your wheels for a long time (over forty years) and wish to use some more—I will want wheels for saw gumming, also special wheels. I will take up with you a little later the matter of these special wheels."

F. W. Shuls, Galion, Ohio.

Here's proof that Staralon Wheels "make good," and make friends and keep them. Tell us what you grind and let us select a Staralon Wheel for you, or order from the catalog.



"STARALON"

DETROIT-STAR GRINDING WHEEL CO.
DETROIT Established 1872 MICHIGAN, U. S. A.

Woods Tool and Cutter Grinder

Universal machine of the swivel head type, designed for tool-room grinding; equipped with automatic longitudinal feed, which provides 12 table speeds varying from 24" to 143" per minute.



No. 2½ Machine

Table travels 22" longitudinally, 7½" cross and 10" vertically, accommodates work up to 22" long and 9" diameter; has automatic cross feed and taper attachment which permits 1/16" taper per foot.

Made in Three Sizes—Circular on Request.

WOODS ENGINEERING CO.

ALLIANCE, OHIO

BLOUNT

Ball-Bearing Motor Buffs

Floor or Bench Type



5 Sizes—¼ to 3 H.P. inclusive

J. G. BLOUNT CO., Everett, Mass.

MARSCHKE Grinders, Buffers and Combination Machines



Spindles of these machines are equipped with four sets of S.K.F. Ball Bearings—motor bearings being entirely independent of outboard bearings. Five sizes ranging from 1½ to 10 h.p. Easy start and stop devices and other features described in circular—send for a copy.

MARSCHKE MANUFACTURING CO.

INDIANAPOLIS, IND.

BATH

Universal Grinding Machines

for Cylindrical, Surface, Internal, Disc, Tool and Cutter Grinding. Built by

UNIVERSAL GRINDING MACHINE CO.

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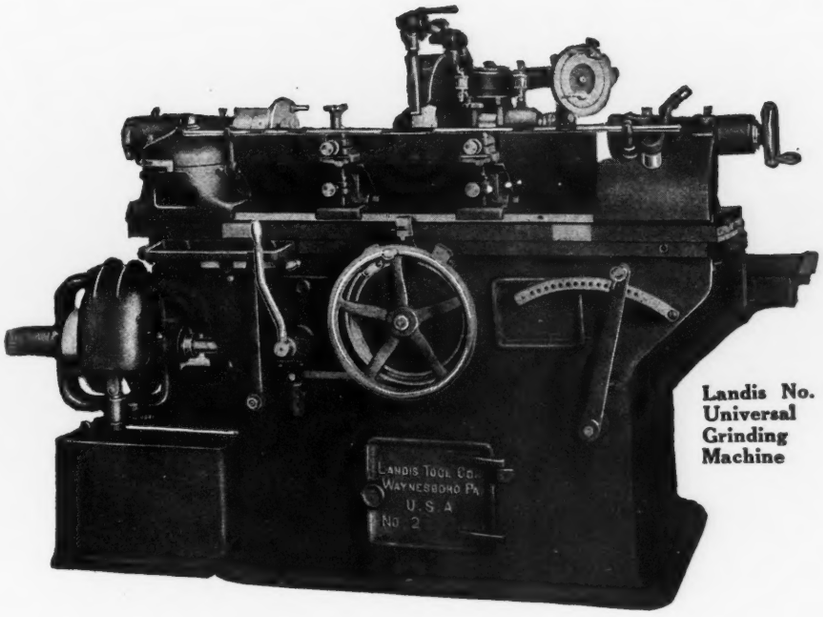
FITCHBURG

Cylindrical Grinding Machine

Various sizes, both Power Feed and Hand Operated, for work up to 54 inches in length.

FITCHBURG GRINDING MACHINE CO.

FITCHBURG, MASS., U. S. A.



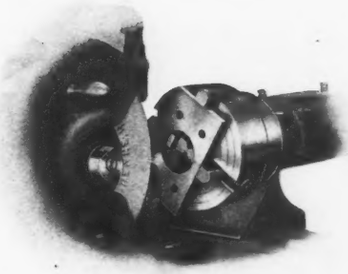
Landis No. 2 Universal Grinding Machine

Grinding in Railway Repair Shops

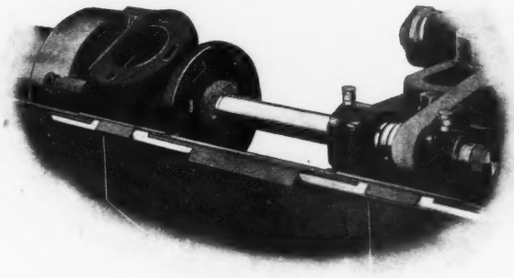
Ultimate economy in finishing internal or external surfaces — straight or taper work—indicates the use of LANDIS GRINDING MACHINES.

The Landis Universal Grinding Machine is the most versatile and satisfactory grinding machine made—grinds straight and taper, external and internal, making it equally valuable for either the tool-room or the repair shop.

It grinds accurately, rapidly and economically such parts as reamers, gages, boring tools, dies, arbors, flue cutting and expanding tools, knuckle pins, crosshead pins, link blocks, link bolts, triple valves, engineer brake valves, etc. In fact, any work that can be held by either a faceplate or chuck can be ground to advantage on this machine.



Link Block Plate



Triple Valve

Simple construction, easy operation and convenience, rigidity, accuracy and great power, insure high production and low operating costs. High grade tools and other work adaptable to these machines are turned out day after day with complete satisfaction.

Ask for catalog

LANDIS TOOL COMPANY

WAYNESBORO PA.

New York Office: **51 CHAMBERS STREET**

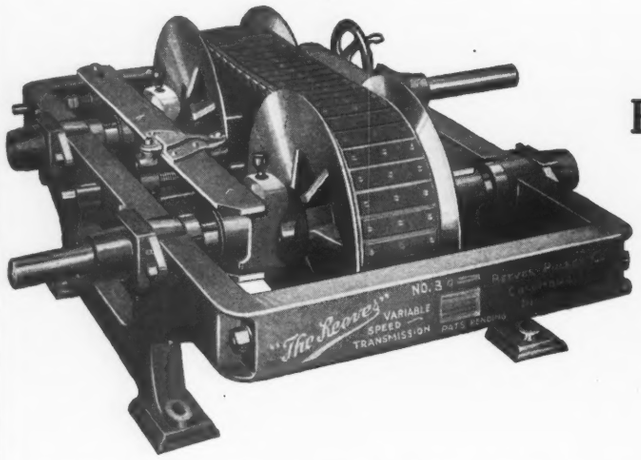
DOMESTIC AGENTS—Hallidie Machinery Co., Seattle; Smith, Booth, Usher Co., San Francisco and Los Angeles; Peden Iron & Steel Co., Houston. Fulton Supply Co., Atlanta; F. C. Richmond Machinery Co., Salt Lake City.

CANADIAN AGENTS—F. F. Barber Machinery Co., Toronto; Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Nova Scotia, New Brunswick, Manitoba and British Columbia.

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Infinite Variation of Speed Quickly Obtained

"The Reeves" VARIABLE SPEED TRANSMISSION



REGULATES—

the speed of any machine or conveyor and enables the operator to get

FAST SPEED
MEDIUM SPEED
SLOW SPEED or
ANY IN-BETWEEN SPEED

desired even to a fraction of a revolution.

"THE REEVES" Transmission is installed between the source of power—motor, line shaft or engine, and the machine to be regulated.

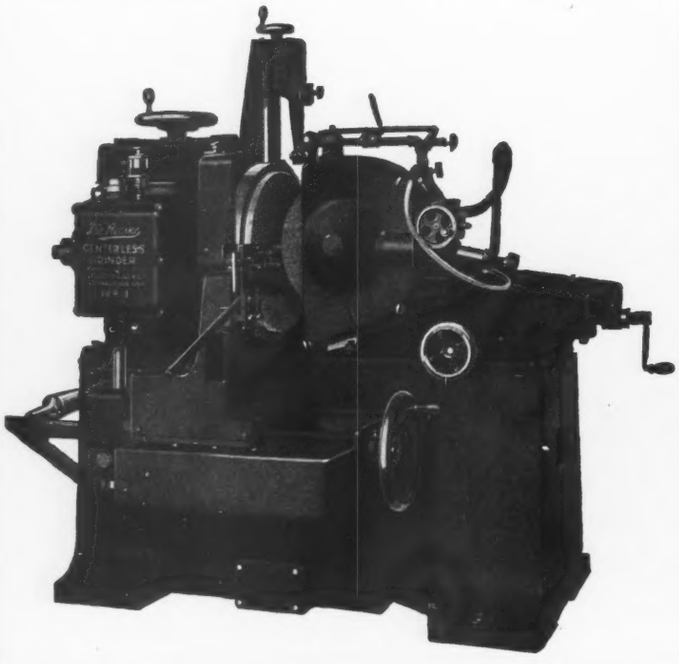
Any one speed may be maintained indefinitely or the speeds may be changed as often as necessary. The power transmitted is steady and positive at all times. It is possible to get a variation as low as 2 to 1 or as high as 16 to 1.

Put your variable speed problems up to us. Write for new 52-page catalog M-44.

REEVES PULLEY COMPANY, Columbus, Ind.

"The Reeves" CENTERLESS GRINDER

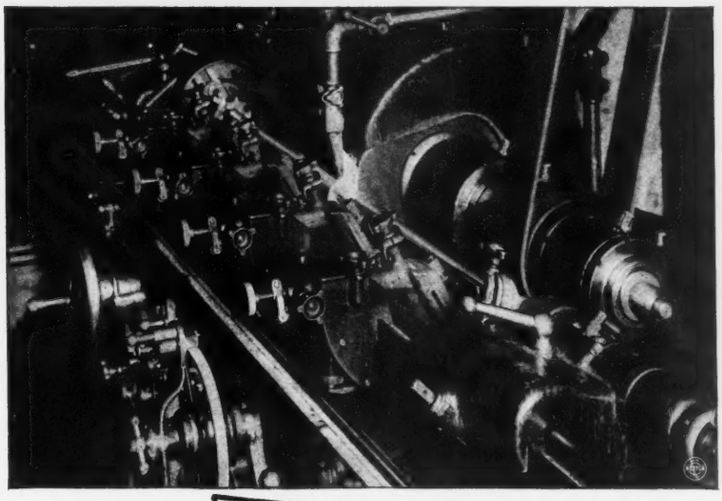
The design of "The Reeves" Centerless Grinder is radically different. The distinctive DROP-IN work rest, which is thoroughly covered and protected by patents, makes grinding of shoulder, taper and straight pieces a very simple affair.



Engineers and factory superintendents are now beginning to realize that in a great many cases where work is ground on centers it is costing too much. They have learned that "The Reeves" way not only increases production considerably, but also turns out more accurate and uniform finish.

Do not be satisfied that you are getting precision grinding on your work until you have tried "THE REEVES" Centerless Grinder. We will gladly demonstrate its wonderful possibilities on any samples you may submit.

REEVES PULLEY CO.
COLUMBUS INDIANA

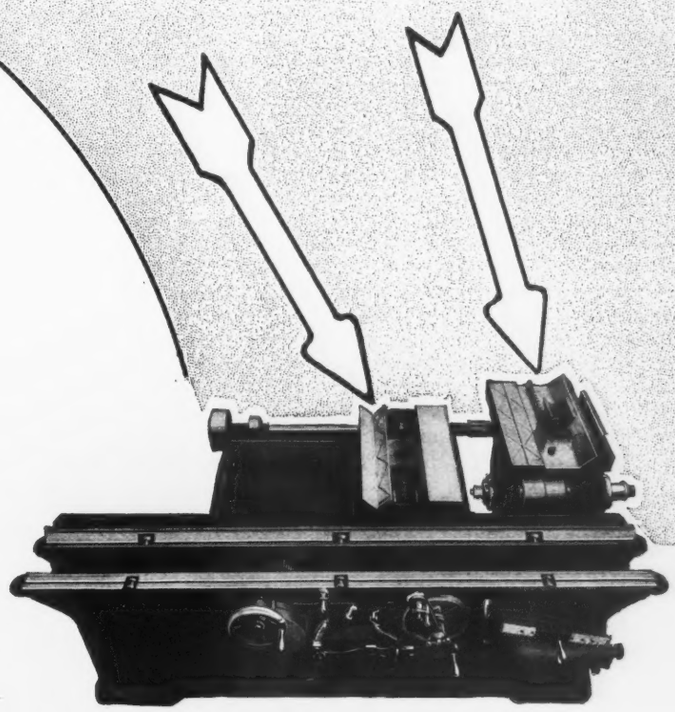


TRADE NORTON MARK

The wheel feed mechanism of the NORTON CYLINDRICAL GRINDING MACHINE indicated by the arrow in the upper illustration is the controlling and adjusting part of a large micrometer. It can quickly and easily be adjusted for measurements of 0.00025" and such limits maintained in regular production. THE INDEX ALWAYS REMAINS IN THE SAME CONVENIENT PLACE under the right hand of the operator, who can readily change it as required without even looking at it.

The lower view shows the massive construction of the base and large proportions of table and wheel slide ways. These ways support the tables and wheel slides which are designed to remain in position from their own weight, NO GIBS BEING REQUIRED.

The half nut on the under side of the inverted wheel slide and the wheel feed screw in the base of the machine convey the accuracy of the wheel feed mechanism to the grinding wheel.



NORTON COMPANY
WORCESTER - MASS.

NEW YORK
53 Park Place

CHICAGO
11 North Jefferson St.

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233 W. Congress St.

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442 Engineers' Bldg.

HARTFORD
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206 Keith Theatre Bldg.

PHILADELPHIA
3208 Market St.

PITTSBURGH
421 Wood St., Room 404



Have You Met An S.G.E.?

An S. G. E.—Sterling Grinding Engineer—is a shop man. A graduate of the only school of grinding there is—the school of practical experience.

He brings to industry this practical knowledge; he brings to industry a sincere desire to help make better grinding and better grinding results, and he is supported wholeheartedly by this old and powerful organization; by a broad general policy of service, and by a background of grinding experience as old as grinding itself.

All this is giving impetus to the rapid development of grinding—more grinding and **better grinding.** These are the things that a Sterling Grinding Engineer likes to talk to you about. He wants to talk shop with you to the end that you do better grinding.

And he can tell you of some really important achievements with Sterling Wheels and Sterling Service. Invite a Sterling Grinding Engineer in. Get acquainted with him. Let him tell you about Sterling Wheels and Sterling Service and the results that have been accomplished.

STERLING

THE STERLING GRINDING WHEEL CO.

A Complete Source of Supply

Cleveland Grindstones

Power or Hand Operated
Mounted and Unmounted
Iron and Wood Frames
Commutator Stones
Oil Stones
Etc.

Sterling Abrasives

Sterlith Wheels
Sterbon Wheels
Vitrified Wheels
Silicate Wheels
Elastic Wheels
of every size and shape
Sterbon Round Knife Sharpeners
Sterbon Abrasive Files
Sterlith Scythe Stones
Sterling Bricks

Sterling Grinding Machinery

Bench, Floor, Swing Frame and Wet Tool Grinding Machinery

THE STERLING GRINDING WHEEL CO.
Division of
The Cleveland Stone Co.

The Cleveland Stone Co.

CLEVELAND, New York and Boston
THE STERLING GRINDING WHEEL CO., Tiffin, Ohio, and 30 No. Clinton St., Chicago.
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STERLING ABRASIVES

AND STERLING GRINDING MACHINES

When You Buy a Dillon Electric Buffer or Grinder

You get an efficient, easy running trouble proof machine. The motor is especially constructed to meet the heavy demands made on this type of buffer and grinder. It is dustproof and trouble proof. It has ample power to drive the machine to full capacity without strain and can be operated 24 hours a day without running hot. Spindles running in S.K.F. Ball Bearings insure easy operation.

Strong, well-balanced construction and convenient design make these machines both efficient and serviceable — a surely profitable investment.



The Dillon Heavy Duty Buffer Pedestal Type

Dillon Medium Duty Grinders and Buffers are made in ½, 1 and 2 H.P. sizes, Bench and Pedestal Types.

Dillon Heavy Duty Grinders and Buffers are made in 3, 5 and 7½ H.P. sizes, pedestal type only.



The Dillon Medium Duty Grinder Bench Type

The Dillon Electric Company

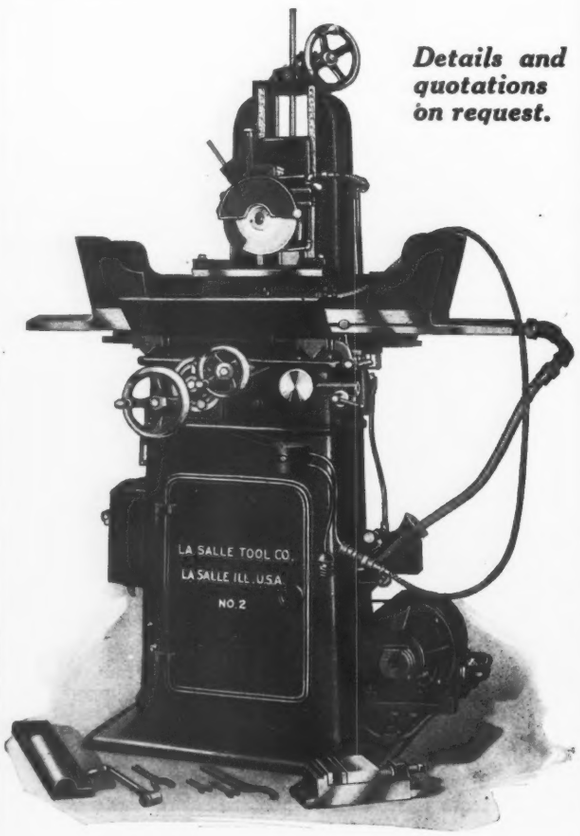
CANTON, OHIO, U. S. A.

LA SALLE
SURFACE GRINDER

Here's a Good Grinder for Truing and Surfacing—Die and Toolwork or Production

Besides more than ordinary rigidity, durability of alignment and operating convenience than is usually found in machines of this class, the No. 2 "La Salle" is provided with an attachment which automatically supplies water to the wheel while it is in operation, and a wheel truing device cast integral with the wheel which permits trueing the wheel without disturbing the work.

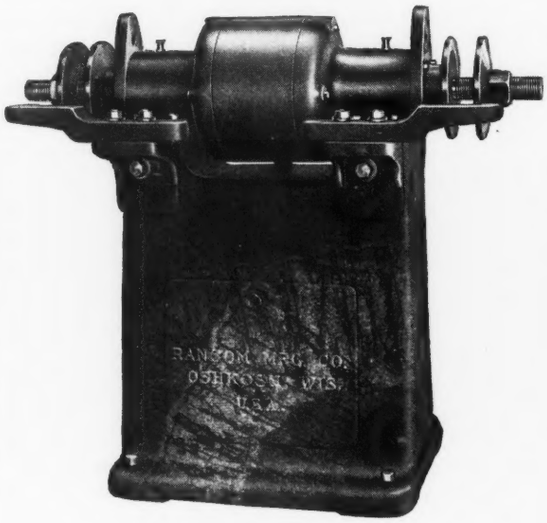
This machine will grind work up to 20″ long, 6″ wide and 10″ high with a 7″ wheel; work table is 49″ long and 8″ wide and travels automatically in both directions. Vertical spindle movement is controlled by a handwheel graduated in .0005″; machine is arranged for belt or motor drive and occupies 3 by 6 feet of floor space.



Details and quotations on request.

La Salle Tool Company
LA SALLE, ILLINOIS, U. S. A.

RANSOM
Heavy Duty—Ball Bearing Grinders



16-inch Wheels or Larger

Write for Catalog.

RANSOM MANUFACTURING CO.
Oshkosh, Wis., U. S. A.

A Diamo-Carbo for Each Grinder

There's no excuse for grinding with wheels out of true. The cost of this dresser is so low, its efficiency so great, that a Diamo-Carbo Emery Wheel Dresser is regular equipment at each machine in many plants. Try it at our expense.

Send for a catalog of our grinding tools. Huntington, Sherman, magazine, etc. Diamonds in stock for selection.



The Desmond-Stephan Mfg. Co.
URBANA **OHIO, U. S. A.**
The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont.
Alfred Herbert, Ltd., Coventry, England, Agent for Great Britain.

BADGER TOOL COMPANY
Grinding Machinery Supplies and Accessories

E. B. GARDNER, President R. D. GARDNER, Treasurer
BELOIT, WISCONSIN, U. S. A.

Emery Wheel Dressers
Two Sizes **Nos. 1-2**
CUTTERS

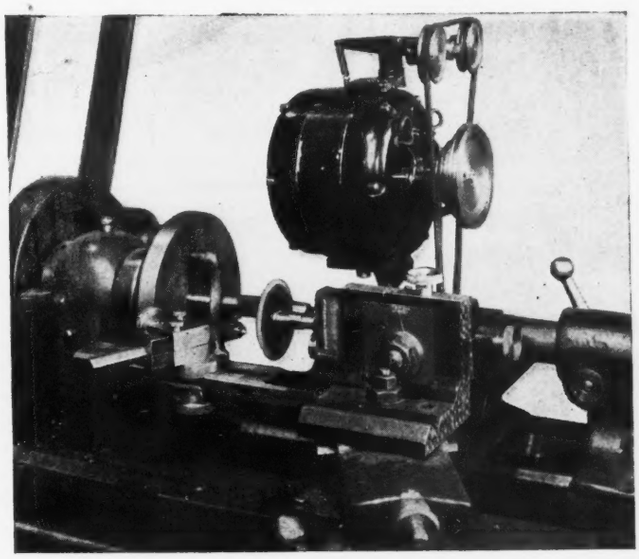
We make the regular Huntington (Pattern) for all sizes. Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEO. H. CALDER CO., Lancaster, Pa., U. S. A.

THREAD GRINDING

1923 Model Multi-Graduated Precision Grinder and Precision Thread Lead Variator

For Grinding Thread Gages, Taps, Hobs, Chasers, Roll Thread Dies—also for Cylindrical and Internal Grinding



PRICE REDUCED 20%

The 1923 Model has many improvements; is more accurate; free from vibration; has greater power and capacity.

At present price is now within reach of smaller shops. Soon pays for itself.

Used by hundreds of nationally-known machine, tool, automobile and metal working plants.

Send for New Hand Book on "THREAD GRINDING"—Just Issued

"Cold-Set" Diamonds do not require resetting. Send for Circular.

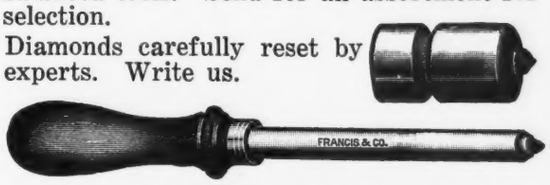
PRECISION & THREAD GRINDER MFG. COMPANY

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Francis Diamond Hand and Grinder Tools

High quality diamonds correctly set in well-balanced tools. Send for an assortment for selection.

Diamonds carefully reset by experts. Write us.

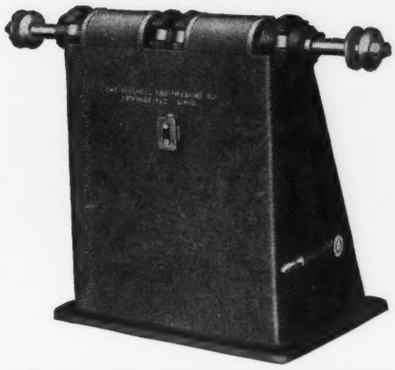


FRANCIS & COMPANY

Established 1799

50 State St. First National Bank Bldg. Hartford, Conn., U. S. A.

MOTOR DRIVEN POLISHING LATHES



A self-contained Motor Driven Unit with which it is possible to obtain any desired spindle or wheel speed regardless of motor speed.

Catalog ?

The Mitchell Engineering Co.

SPRINGFIELD, O.

Industrial Diamonds

The Wheel Trueing Tool Company, through its overseas connections, can furnish industrial diamonds in any grade, size or quantity. These diamonds are sorted into packages that will meet the individual requirements of your plant.

Next in importance to buying diamonds that exactly fill your needs is the proper mounting of the stones. Our laboratory, the largest of its kind, is devoted exclusively to the making of our perfected mountings and to working out our unique factory cost keeping service to diamond users.

BORTZ DIAMONDS CARBON

WHEEL TRUEING TOOL CO.

ESTABLISHED 1910

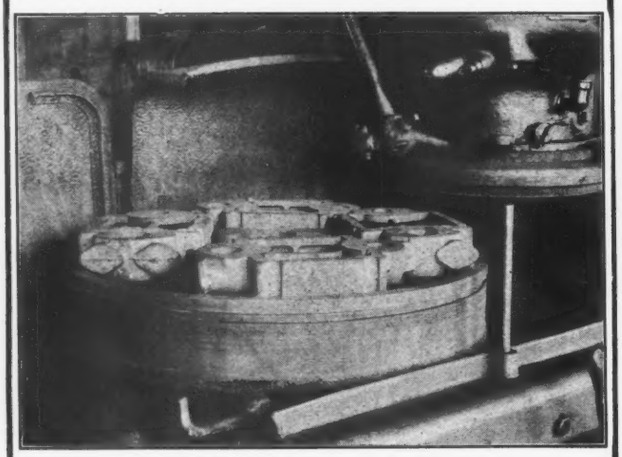
DIAMOND TOOLS FOR EVERY MECHANICAL PURPOSE

2130 PENOBSCOT BLDG. DETROIT, MICH

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GREAT NORTHERN BLDG., CHICAGO ST. CATHERINES, ONT.

ENGINEERS BLDG., CLEVELAND



BLANCHARD GRINDERS
in the
STEAM PUMP SHOP

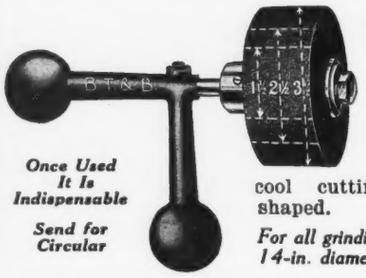
Duplex Pump Steam Chests
14 in. x 8½ in. x 2¾ in.

No. 16 Blanchard Grinder
30 in. Magnetic Chuck
Material, Cast Iron
Stock per side, ⅛ in.
Limits, ± .003 in.
No. of Sides, 2
Production, 15 pieces (30 surfaces)

"A Better Product for Less Money"

THE BLANCHARD MACHINE CO.
64 State Street, Cambridge, Mass.

EMERY WHEEL DRESSERS



Once Used It Is Indispensable

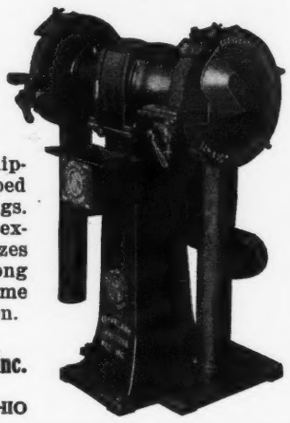
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Dressers which will shape a grinding wheel like holding an icicle on a hot stove. The Metcalf Dresser is a marvel for keeping wheels clean, cool cutting and properly shaped.

For all grinding wheels up to 12- or 14-in. diameter, 1-in. or less thick.

Machinery Company of America
BIG RAPIDS MICH., U. S. A.

Announcing the
C. A. W. Grinders, Buffers



Polishers, Tire Buffers, equipped with Timken Tapped Adjustable Roller Bearings. The products of 28 years' experience. Made in all sizes and types. Liberal long term payment plan. Some dealers territory still open.

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4732 St. Clair Ave.
CLEVELAND OHIO

Bridgeport Motor Driven Grinders



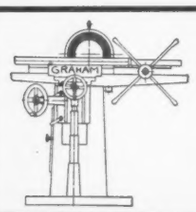
Built for Work

Carefully built, well-balanced machines with every provision to insure rigidity, reduce vibration and give accuracy — particularly good on heavy operations.

Direct motor drive practically eliminates power waste. Extra large spindles have four ball bearings per spindle. Send for catalog.

Strong and Powerful A. C. or D. C. Motor

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GRINDER
Knee Type Ring Wheel
For Flat Surfaces

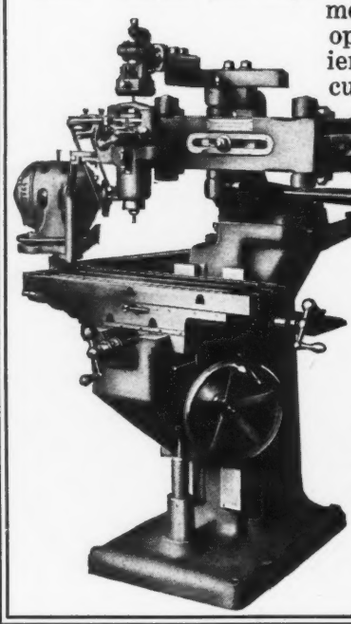
THE GRAHAM MFG. CO.
Providence, R. I.

KELLER AUTOMATIC MACHINES
CUT DIES TIME COST

KELLER MECHANICAL ENGINEERING CORP.
74 WASHINGTON ST. BROOKLYN, N.Y.

Make Heavy Die-sinking and Engraving Profitable

The Gorton No. 1S has ample power to do the work quickly and *accurately*. For example, it cut a 2″ letter in 9/64″ relief in *cold rolled steel* in 15 minutes; a letter the same size 5/16″ relief in *bronze* in two minutes. Ample provision for precise adjustment and special operating conveniences insure accuracy.



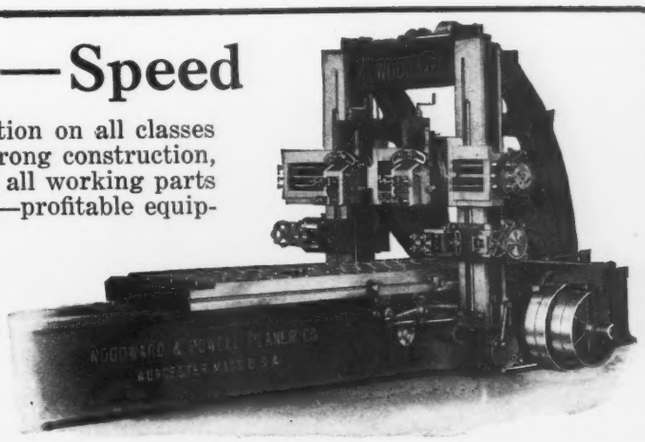
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Geo. Gorton Machine Co.
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Racine, Wis.

Power—Accuracy—Speed

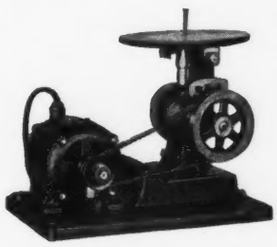
Woodward & Powell Planers promote production on all classes of planer work. Wide range, ample power, strong construction, convenient operation and easy accessibility of all working parts make these machines efficient and economical—profitable equipment wherever work is heavy and varied.

Standard, Medium and Heavy Duty Types. Belt or Motor Drive. Send for details of the special features.



Woodward & Powell Planer Co.
Worcester, Mass., U. S. A.

Illinois Die Filing Machine



The "Illinois" Die Filer is very compact, and the work done by it is extremely accurate without sacrifice of efficiency or production.

An illustrated booklet of interest to every Die-maker will be sent Free on request.

ILLINOIS TOOL WORKS
160 E. Erie Street CHICAGO, ILL.

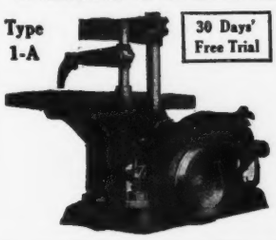
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Are Real Productive Machines!

They saw or file 30% faster than any other like machine. Use any standard tapered or crooked file up to 12". Patented device holds any length saw blade and positively prevents buckling. Will file to shoulder or in blind corners.

Type 1-A

30 Days' Free Trial

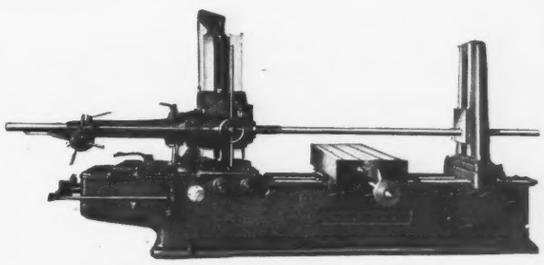


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"Inflexible Rigidity—Lasting Accuracy"

Let us tell you of the many *advantages* of this machine and all the *economies* it can effect in your operations. Take a minute *now* and write for descriptive circular. Blomquist-Eck engineers are at your service.

The Blomquist-Eck Machine Co.
1146 E. 152nd St. CLEVELAND, O.

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For Making IRON AND BRASS WOOD-SCREWS

Machines built to capably produce accurately cut screw slots, screw threads and gimlet points. Modern up-to-date equipment furnished for Wood-Screw Plant installations.

Send for Catalog 7-H **HARTFORD, CONN., U. S. A.**

SCREENS OF ALL KINDS

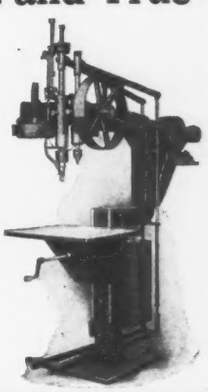
Chicago Perforating Co.
3445 West 24th Place
Tel. Canal 1459 CHICAGO, ILL.

Perforated Metal Machinery Guards

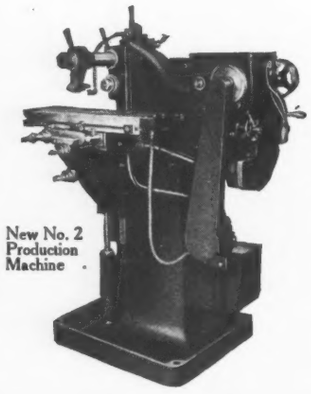
Drives Screws Fast and True

The Reynolds Automatic Magazine Fed Screw Driving Machine has made some remarkable reductions in assembling costs by setting screws 2 to 6 times faster than the most skillful can do by hand. They're set uniformly, to any desired depth and without marring work or screw heads.

Send over-all dimensions of work and length and gauge of screw —for estimate.



The Reynolds Machine Co.
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Massillon Ohio, U. S. A.



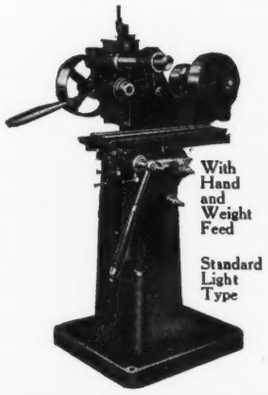
New No. 2 Production Machine

WE BUILD

Light, Medium and Heavy Duty Hand Milling Machines.
Hand and Power Feed Millers.
Spline Milling Machines.
Automatic Milling Machines of many types and designs.
Centering Machines.
Drilling Lathes.
Special Machinery.

Let us tell you more about them

Standard Engineering Works
PAWTUCKET, RHODE ISLAND

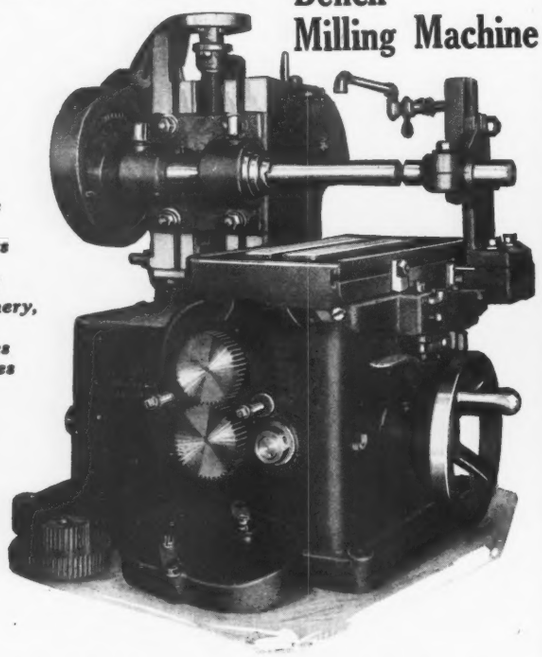


With Hand and Weight Feed

Standard Light Type

The WEED Semi-automatic Bench Milling Machine

We are also Builders of Special Machinery, Jigs, Fixtures and Dies



Designed for the accurate and rapid production of interchangeable parts. Quick operating adjustments. Speed and feed to suit the job.

THE WEED ENGINEERING WORKS
740 Union Avenue BRIDGEPORT, CONN.

BENCH MILLING MACHINE



For Small Work in Large Quantities

This machine is built with the same care as our larger millers; it is accurate and right in every particular; highly profitable on a wide variety of small work. Can be had with floor column if desired. Ask for complete description.

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Sterling Place **WINSTED, CONN.**

Let us show you records of BRIGGS MILLING

on jobbing and manufacturing—keyseating, slotting, trueing, surfacing, etc., with gang and form cutters—and on just plain milling on a production basis.

We're not bragging—we know you'll be interested.

GOOLEY & EDLUND, Inc.
CORTLAND, N. Y.

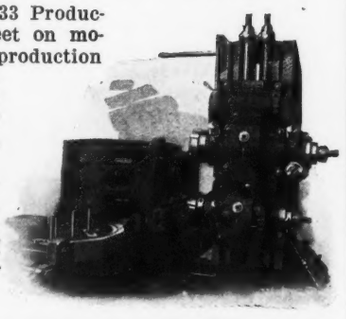
OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U.S.A.

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100% Increase in Production

This Kempsmith No. 33 Production Miller milling feet on motor frames, doubled production by using two spindles and cutters instead of one. Result: Heavier feed, increased speed, twice the output.
Get a Kempsmith estimate on your work. No obligation. We can save time on 80% of your milling operations.



Let us show you.

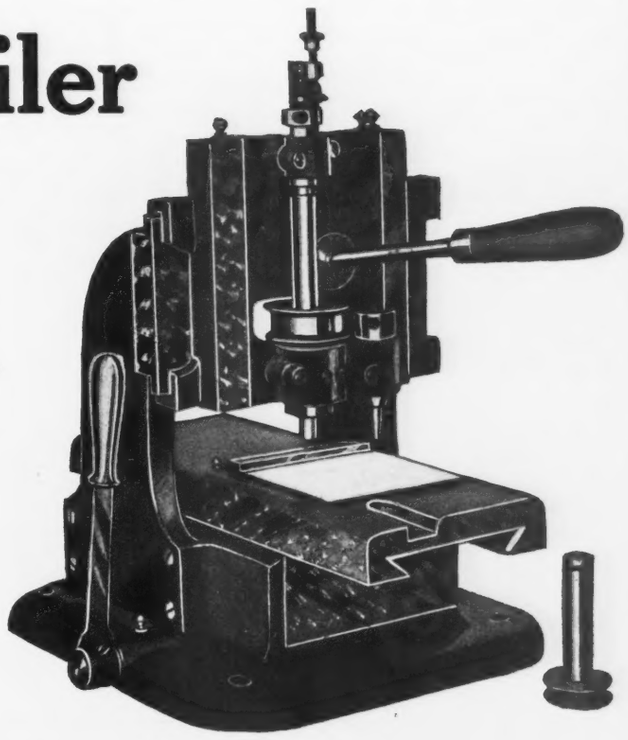
KEMPSMITH MFG. COMPANY
MILWAUKEE **U. S. A.**

Bench Profiler

A rigid machine for quickly profiling or vertical milling your small parts. Can be depended on for accurate duplication of form and its handiness and ease of operation keeps the work moving.

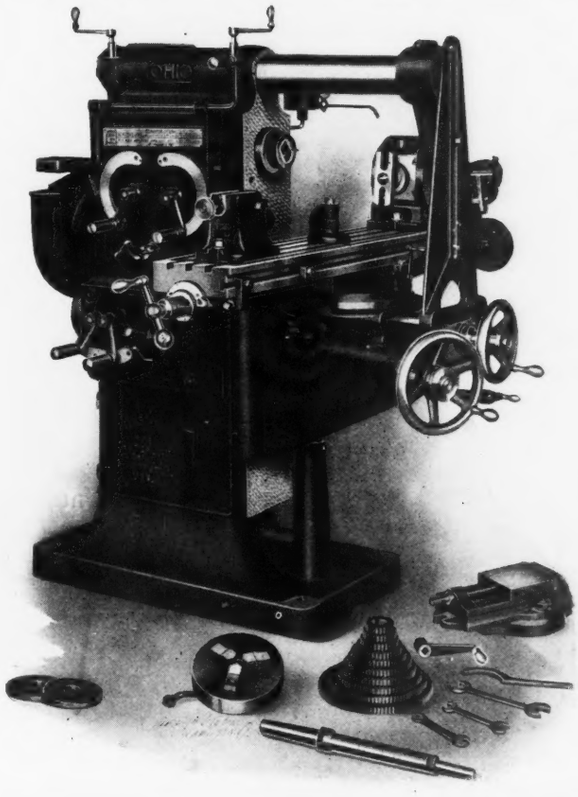
Cutter Spindle takes No. 5 B & S Taper. Cutter covers an area 4" x 1¾".

Send for circular.



THE WADE-AMERICAN TOOL COMPANY
49-59 River Street **WALTHAM, MASS.**

A Machine Every Manufacturer Will Appreciate



The Ohio All-geared Milling Machine

A good serviceable machine, which combines all the essentials for modern milling practice in the simplest and most effectual way.

Three shafts—spindle, pulley and one intermediate—provide 16 successive speed changes without stopping the machine.

Oil is fed by gravity—by means of seeps, wicks, tubes and splashing, without pump or other motive part—into 3 successive reservoirs, so arranged that only clean, fresh oil reaches the spindle and main bearings.

All operating levers are handy to working position; automatic brake provides a quick stop for the spindle; every gear in the machine is pack-hardened and Ohio Specialized Construction prevails throughout.

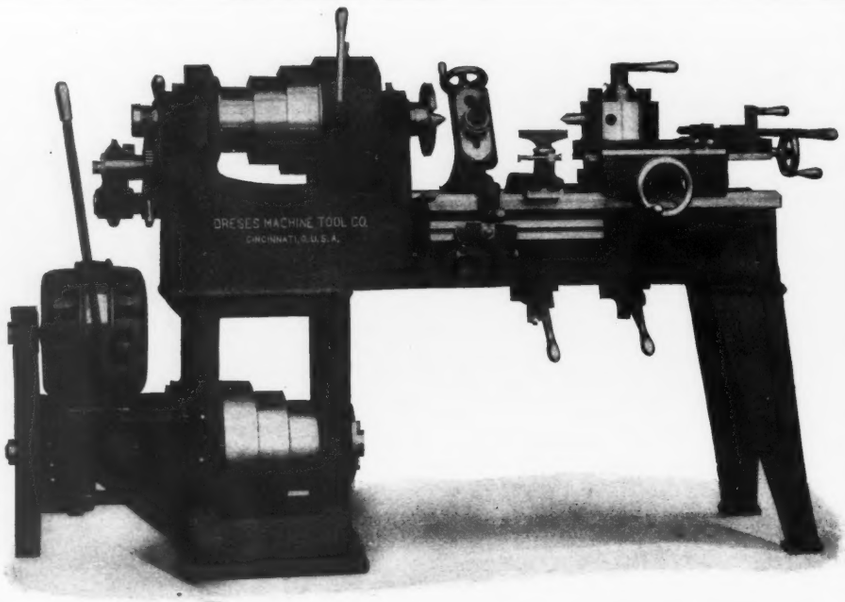
These machines are built in 6 sizes in both plain and universal types—rigid, well-balanced and of best material. Circular on request.

THE OESTERLEIN MACHINE CO.
CINCINNATI **OHIO, U. S. A.**

MILLERS OHIO GRINDERS

"Tools in Which Every Ounce Works"

Motor Driven Turret Lathes and Screw Machines



Geared speed changing devices are not practical for very high speeds. The motor mounted on the headstock looks unsightly and sets up undesirable vibrations. We place the motor on a bracket close to the floor where it takes up little room, reduces the vibration and allows a long belt for the pulleys. A rawhide pinion on the armature shaft insures noiseless running. A mechanical friction clutch starting, stopping and reversing device between the motor and lower shaft eliminates an expensive and complicated electrical controlling arrangement. For variable speed motors, single pulleys instead of cone pulleys are used.

THE DRESES MACHINE TOOL CO., Cincinnati, Ohio

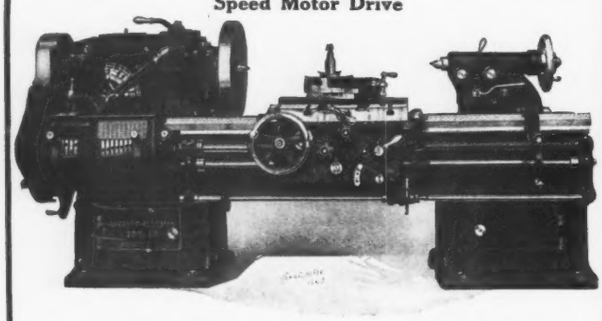
Greaves-Klusman Lathes

Always Ready for Current Demands

G-K "Betterments" always anticipate requirements—as witness the growing tendency of manufacturers to look for greater ruggedness and durability in selecting equipment.

The ribbing in G-K Lathes extends the *full* depth of the bed; the spindle is set *back* of the center line and the feed-rod is supported at *both* ends of the apron.

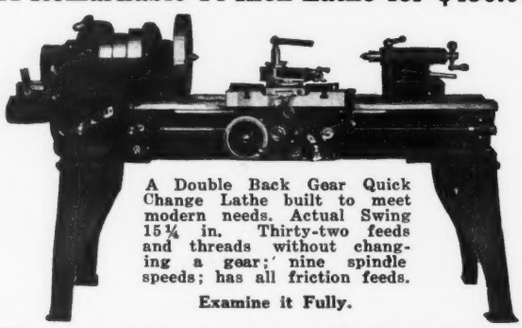
Heavy Quick Change Engine Lathes—
14", 16", 18", 20", 24", and 30" sizes
Flexible Motor, Geared Motor Drives and Variable Speed Motor Drive



Circulars or Complete Catalog Sent on Request.

The Greaves-Klusman Tool Co.
CINCINNATI OHIO, U. S. A.

A Remarkable 14-Inch Lathe for $450.00!



A Double Back Gear Quick Change Lathe built to meet modern needs. Actual Swing 15¼ in. Thirty-two feeds and threads without changing a gear; nine spindle speeds; has all friction feeds.

Examine it Fully.

The Carroll & Jamieson Machine Tool Co.
253 Davis Avenue, Batavia, Ohio

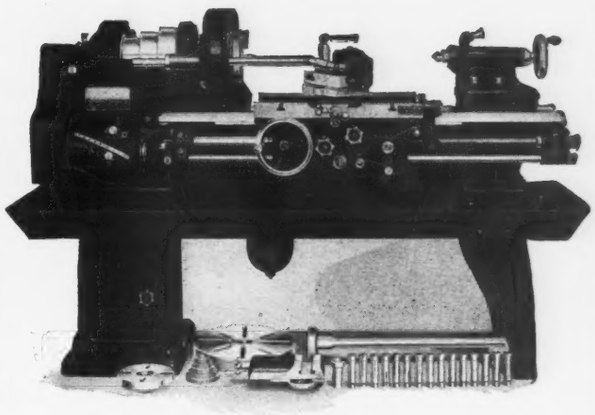
HAMILTON LATHES

Standard type machines that give better than average service.
Look them over at our nearest agent.

Hamilton Machine Tool Company
HAMILTON OHIO

Steinle Turret Machine Co.
THE FULL SWING SIDE CARRIAGE
TURRET LATHE
STEINLE TURRET MACHINE CO.
MADISON WISCONSIN U. S. A.

Monarch Tool-room Lathes



16"x6' Monarch Tool-Room Lathe with full equipment, including *UNIVERSAL Relieving Attachment, Taper Attachment, Draw-in Attachment, Chasing Dial* and *Chasing Stop*

Many other sizes of Monarch lathes can be furnished with complete tool-room equipment. Complete range of sizes 9-inch to 30-inch swing.

Special features of Monarch tool-room lathes include the following:

Full double plate apron with all drop-forged steel gears and central oiling system for back plate.

Efficient full Universal Relieving Attachment which is quickly attached and removed from the lathe.

Has all the features required for the rapid accurate making of tools and gauges.

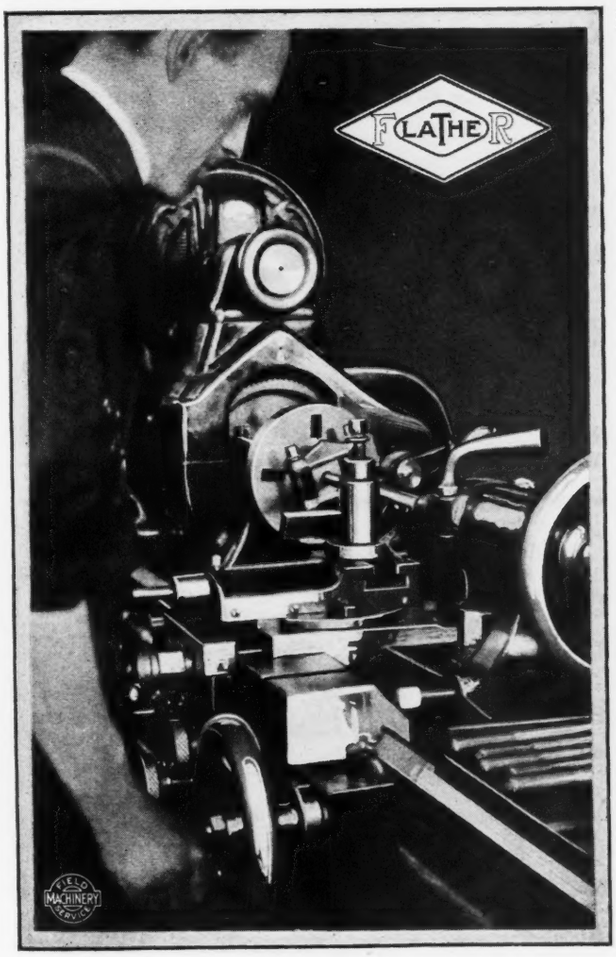
Is constructed of the very finest materials and in sufficient quantity to justify the most modern methods of duplicate quantity production in their manufacture.

Monarch lathes are *manufactured* in quantity, not *built* singly or in small lots. As a consequence, Monarch lathes are always attractively priced. Inspection records which are guarantees of accuracy accompany each lathe showing the accuracy of the lead screw for chasing and of the alignment of the lathe for accuracy in turning, facing and boring.

Few lathes equal, and none rival, the Monarch lathe for accuracy and efficiency.

THE MONARCH MACHINE TOOL CO.

209 Oak Street, Sidney, Ohio, U. S. A.



You've Heard About Instant Control—

Here It Is

A motor driven Flather Lathe comes close to perfection in the matter of ready control. It is under the positive and instant command of its operator at all speeds, forward or reverse—and you know, if you have ever run a lathe, that ready, easy control contributes much to output. Also Flather motor drive is *safe*—in case of overload or too quick reverse a safety switch throws out, protecting both the machine and work.

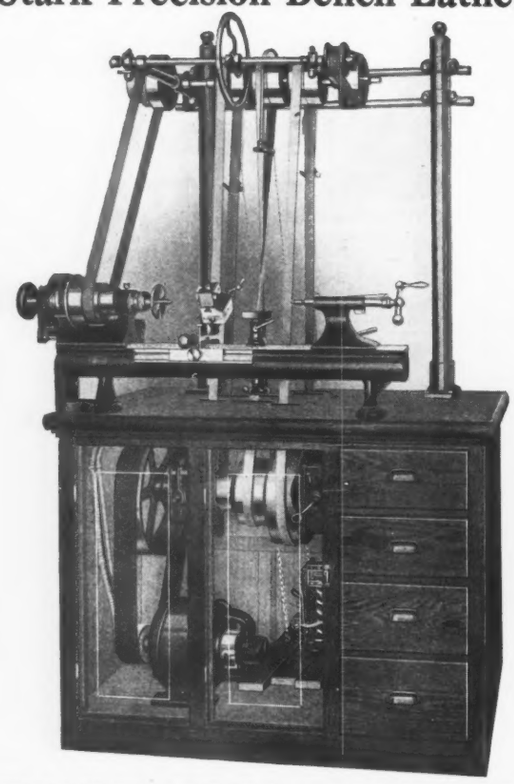
Flather Lathes have exclusive advantages that have been developed during the many years we've been building these machines.

Let us send the whole story

Flather & Company, Inc.

NASHUA N. H., U. S. A.

Stark Precision Bench Lathes



STARK TOOL COMPANY

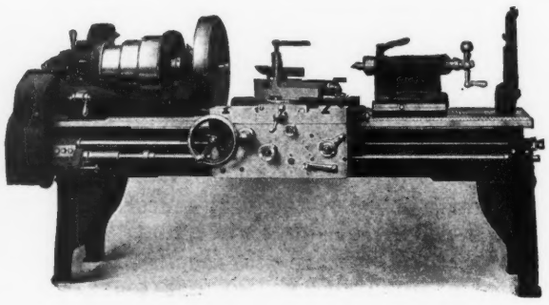
WALTHAM, MASS. Established 1862

Originators of the American Bench Lathe

Bradford Lathes

Standard type engine lathes. Well built, modern machines in sizes from 14 to 42 inches. Cut shows the 20″ standard type 3-step cone, double back geared lathe—a popular size.

Send for a set of circulars of the entire line.



THE BRADFORD MACHINE TOOL COMPANY

Cincinnati Ohio, U. S. A.

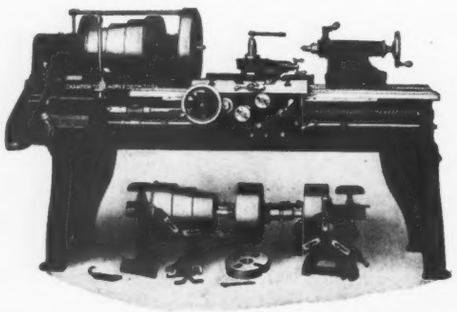
CHAMPION LATHES

More Popular Than Ever

Lathes come and lathes go—but Champion Lathes keep right on the job and are replaced only by more Champions.

One man tells another how useful he finds Champion Lathes, and so the story of their many practical advantages spreads.

It will pay you, too, to investigate the exclusive advantages of Champion Lathes.



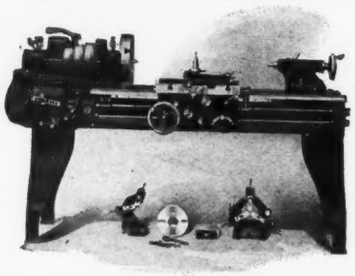
CHAMPION TOOL WORKS

4955 Spring Grove Ave. Cincinnati, Ohio

ROCKFORD "ECONOMY"

Double Back Geared Quick Change Engine Lathes

Machines that assure accuracy and fine finish at profitable speeds and on a wide variety of work. Any of 32 feed changes instantly obtainable and chasing dial provides any thread 4 to 56 per inch, including 11½. Can be used for light manufacturing without spoiling them for the experimental department.

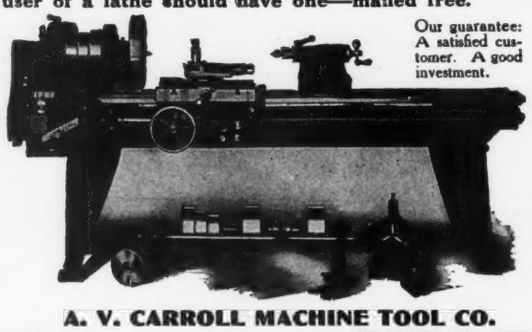


Bulletin on Request

ROCKFORD LATHE & DRILL CO., Rockford, Ill.

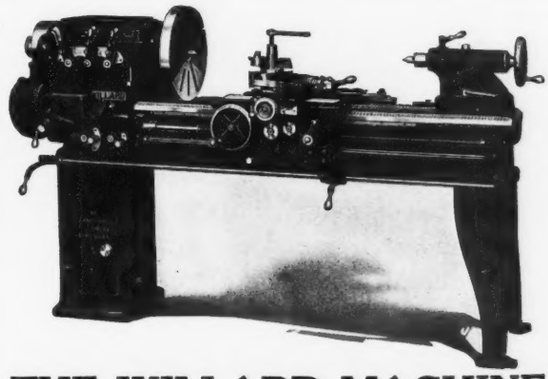
A. V. Carroll Lathes, actual swing 16½″, 19″ in the patented gap. Sizes 12″ to 21″. Send for circular and instructions showing how to save 25%—every user of a lathe should have one—mailed free.

Our guarantee: A satisfied customer. A good investment.



A. V. CARROLL MACHINE TOOL CO.

Station H CINCINNATI, OHIO



"CUT IT SHORT"

It stands to reason you can get somewhere on production by using a WILLARD single pulley drive.

Automobile sliding gears, made of chrome nickel steel, oil hardened and ground, and running in an oil bath. Shafts run on SKF bearings. Apron control. Fool-proof headstock.

Power for roughing; speed and accuracy for finish. "Make it snappy." Time is money.

Write us for particulars.

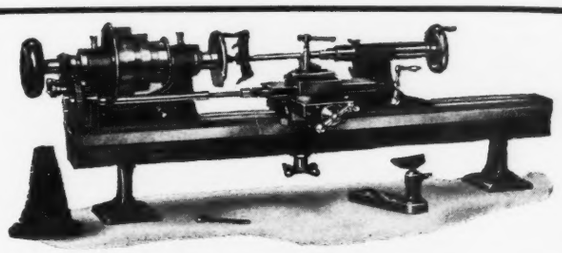
THE WILLARD MACHINE TOOL COMPANY, Cincinnati, Ohio

SIDNEY LATHES

Standard Patterns, Most Needed Sizes

Accurate to .001"; simplified and centralized controls make operation easy; excellent design; careful construction; efficient and economical. 10, 12, 14, 16, 18 and 20 inch sizes. Write for details.

THE SIDNEY MACHINE TOOL CO.
SIDNEY OHIO, U. S. A.



Almost a Complete Machine Shop

An Elgin Precision Bench Lathe with attachments is capable of turning, boring, drilling, milling, sawing, slotting, shaping, grinding, etc. Excels larger tools on production, is unexcelled for precision. Details on request.

ELGIN TOOL WORKS, Inc., ELGIN, ILLINOIS



Hand and Power Marking Machines

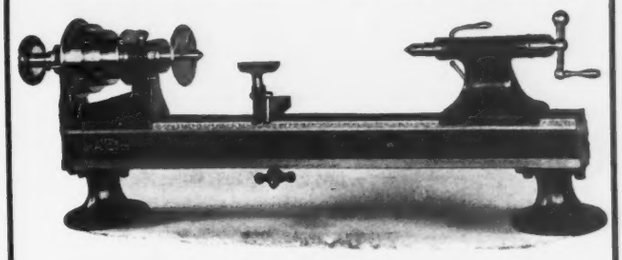
Before You Decide

on a method of marking any new product or if your present method is not satisfactory get our recommendations and a copy of our booklet: "Cost Reduced; Quality Improved."

Write today and let us help you to solve your problems. We also make stamps for every marking purpose.

The Noble & Westbrook Mfg. Co., Hartford, Conn.
"Improved Marking Devices"

Ames Precision Bench Lathes



For Turning, Drilling, Filing, Grinding, Milling and Thread Cutting

There's plenty of work for these versatile machines in tool-rooms and in shops where delicate mechanisms and instruments are manufactured. A wide variety of rests, fixtures, tailstocks, turrets and attachments—including taper, relieving, thread cutting and internal and external grinding—make them practically universal for all work within their range.

Swing over bed is 8⅞", distance between centers 21" and the countershaft provides a choice of 720 or 120 R. P. M.

Let us tell you BC AMES CO WALTHAM MASS U.S.A. ***more about them***

B. C. AMES COMPANY
WALTHAM MASS., U. S. A.

The Automatic Machine Company

BRIDGEPORT CONNECTICUT

Makers of

AUTOMATIC THREADING LATHES
AUTOMATIC HOB THREAD MILLERS
COULTER MULTIPLE SPINDLE PROFILERS
COULTER SHAPING PLANERS
SPECIAL MACHINE TOOLS



Free Catalog No. 79

SOUTH BEND LATHES

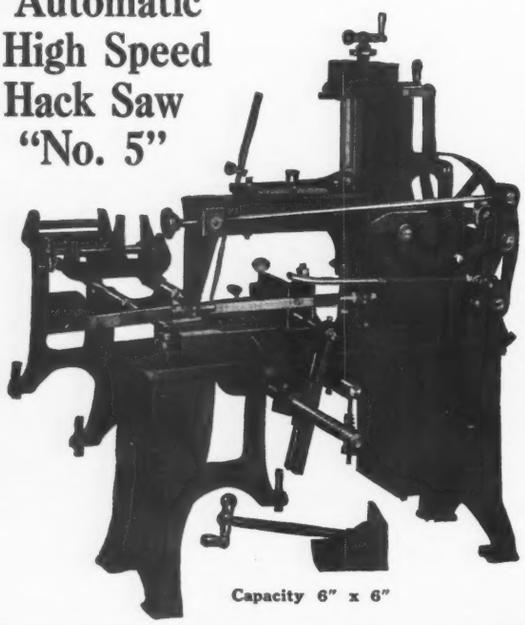
Size of Lathe	Standard Change Gear	Quick Change Gear
13"x 5' Lathe	$304.00	$354.00
15"x 6' Lathe	376.00	431.00
16"x 8' Lathe	452.00	512.00
18"x10' Lathe	656.00	721.00

SOUTH BEND LATHE WORKS
420 Madison Street South Bend, Ind.
New York Salesroom—166 N. Centre St.

Do you Use Lots of Duplicate Pieces?

The No. 5 Marvel Automatic High Speed Hack Saw cuts bar stock into duplicate pieces to length desired. Automatically opens vise after each cut, feeds bar to gauge, closes vise, and resumes cutting, all automatic, and at tremendous cutting speed. The most economical method of cutting duplicate pieces from bars of steel or other metal. Automatic Stock Feed, Swivel Chuck, Adjustable Stroke, Variable Blade Pressure, Draw Cut and Automatic Stops are outstanding features, and provision is made for shifting the frame so as to use up the entire blade.

Marvel Automatic High Speed Hack Saw "No. 5"



Capacity 6" x 6"

This machine is furnished belt or motor drive and takes blades 14" x 1" x .049".

Send for the Catalog of Marvel Hack Saws, Band Saws, Shears, Punches and Drill Press Vises and investigate these efficient tools.

Armstrong-Blum Mfg. Co.
343 North Francisco Ave. CHICAGO, ILL.

VICTOR
HACK SAW BLADES



Victor All Hard and Flexible Blades for hand frames and Victor All Hard Blades for light machine work are made of special tungsten alloy steel and give you special service.

Victor Service includes full information on hack saw blade use, advice on metal cutting, price lists, etc. Write us and let us help you to lower production costs.

VICTOR SAW WORKS
MIDDLETOWN, N. Y.
2009-28

QUALITY
HACK SAWS
"True to the Name"

Specify Quality on your next order and Settle Your Hack Saw Problem.

Napier Saw Works, Inc.
(The Hack Saw Specialists)
Office & Factory, Middletown, N. Y.

Lea Simplex Cold Saws

Our booklet "Economy in Cold Sawing" presents some interesting facts on the Lea-Simplex method of handling this frequently neglected operation.
Write for a copy today.

The Earle Gear & Machine Company
4707-15 Stenton Avenue PHILADELPHIA, U. S. A.
Also Manufacturers of Cut Gears, Special and Bridge Operating Machinery and Earle Centrifugal Pumps

BARNES
SAWS FOR METAL
BAND MANUFACTURED BY HACK
DETROIT W. O. BARNES CO., INC. MICH.

ATKINS

METAL CUTTING SAWS

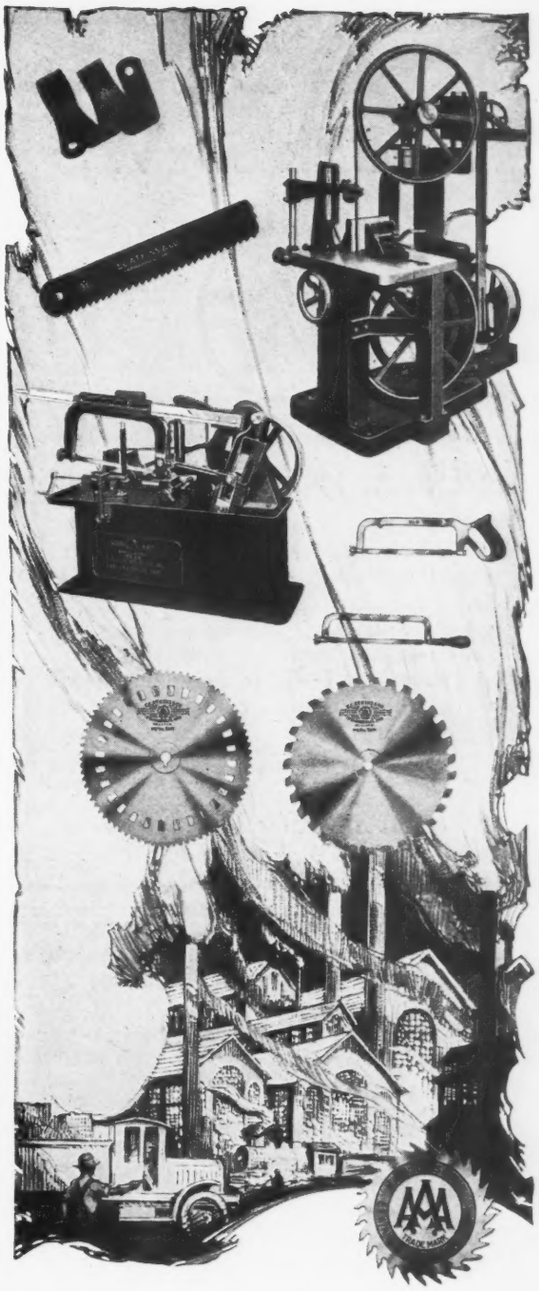
Have Made Sawing Easier and Faster

These better saws and machines are made to save you time, labor and material. It costs you money to use a cheap metal cutting saw or machine. A really good one is an economy.

Labor is scarce. Time is money. Your product is too valuable to trust to poor metal cutting saws and machines. Atkins will save you money and we solicit your inquiry for specific facts covering,

Kwik-Kut Hack Saw Machines
Metal Cutting Band Saw Machines
Non-Breakable Hack Saw Blades
Power Hack Saw Blades
Circular Saws for all kinds of Metal Cutting
Band Saws for Metal Cutting
Frames for Hack Saws

Let us send you informative literature on any metal cutting job. Write us today.



E.C. ATKINS & CO.

ESTABLISHED 1857 THE SILVER STEEL SAW PEOPLE

Home Office and Factory, INDIANAPOLIS, INDIANA

Canadian Factory, Hamilton Ontario

Machine Knife Factory, Lancaster N.Y.

Branches Carrying Complete Stocks In The Following Cities:

Atlanta	New Orleans	Seattle
Memphis	New York City	Paris, France
Chicago	Portland, Ore.	Sydney, N. S. W.
Minneapolis	San Francisco	Vancouver, B.C.



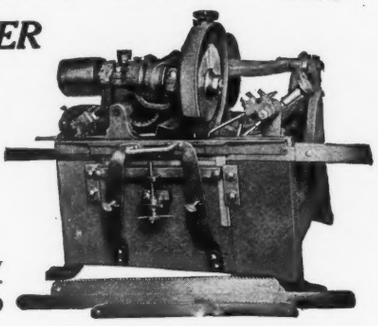
SAW SALVAGE

REDUCES COSTS 40% to 80%

$10.00 WORTH OF SAWS CAN BE RECLAIMED FOR 25c.

IT DOES NOT COST OVER 5c. TO RESHARPEN A

SLITTING, MILLING, SCREW-SLOTTING, HACK OR BAND SAW



The Wardwell Mfg. Co.

Specialty Manufacturers

Combination Band Saw Filing and Setting Machines, Circular Saw Filers, Hack Saw Grinders, Metal Cutting Band Saw Grinders, etc.

108 HAMILTON AVE. CLEVELAND, OHIO

STAR
HACK SAWS

TRADE MARK

The Blade With a Reputation

Star Hack Saw Reputation is built upon the metal cutting performance record of forty years. Stars cut faster and cut longer. Personal service, information, advice and price lists on All Hard and Flexible Hand Blades, and on Power Blades, sent on request.

Clemson Bros. Inc.

Middletown, N. Y.

2008-28

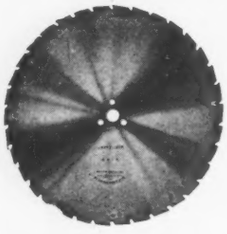
STERLING
HACK SAW BLADES

Finest grade rolled high-tungsten alloy steel, made by special machines and processes. Free-cutting, long-lasting, tough. Sterling Hacksaw Blades, Frames and Machines are for sale everywhere. Ask for them.

Diamond Saw & Stamping Works

357-361 Seventh St. BUFFALO, N. Y.





HUTHER SAWS

Do You Saw Switches, Rails, Frogs, Alloy Steel Spindles?

The economical way is to use a Huther Inserted Tooth Milling Saw on your cutting-off machine. Inserted teeth of high speed steel are almost unbreakable, and wear down 1¼" before renewal is necessary. Cut very thin, and fast. Send for one on free trial—keep it only if it *saves* you money.

Details on request.

Huther Bros. Saw Mfg. Co., Inc.

ROCHESTER, N. Y.

The HIGLEY
COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.

New York Philadelphia New Haven

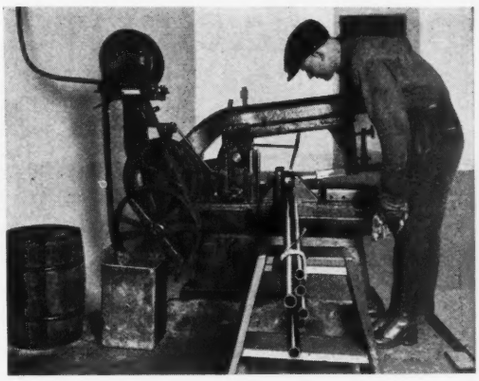


Photo and data obtained at the New York plant of the O. T. Hungerford Brass and Copper Co.

Peerless Hack Saws

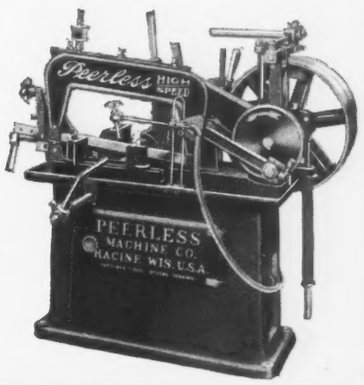
Exclusively at "Hungerford's"

The 4½-year-old machine shown is one of the busiest among the many Peerless Machines in this busy shop—used exclusively for cutting steel tubing ¼" O. D. and No. 20 Birmingham Wire Gage with .035" wall up to 6" O.D. with .075" wall.

When photographed No. 18 Gage Seamless Steel Tubes 1" O.D. with .049" walls were being cut, *six at a time*—the work held securely in a vise, Aqualene fluid for lubricant and cutting time for each set of six lengths, one minute.

Fast, Accurate, Economical and Universal

Peerless Metal Cutting Machines are used for slotting, shaping, etc., as well as sawing *at any angle*. Automatic lift, positive feed control and other features permit big output with minimum blade breakage; assure clean, true cuts at little cost. Let us tell you all about them.



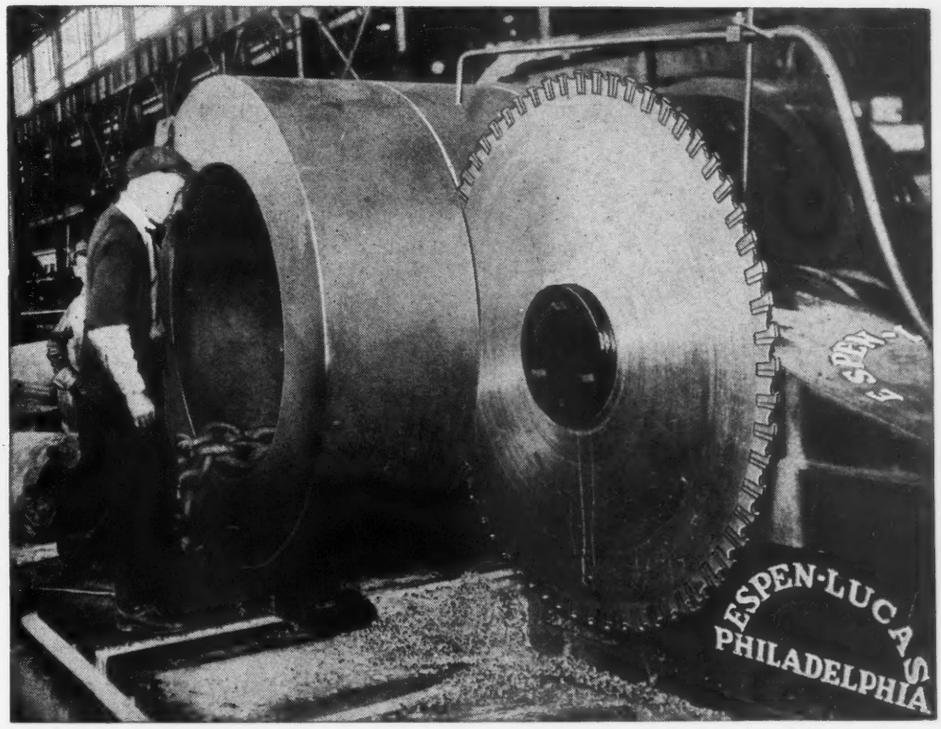
PEERLESS MACHINE COMPANY

17th and Northwestern R. R. RACINE, WIS.

FAST AND ECONOMICAL SAWING

Tell us your needs, we have the knowledge, experience and will to correctly advise.

190 types and sizes of Sawing Machines for sawing all kinds of metal.



THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues PHILADELPHIA, PA.

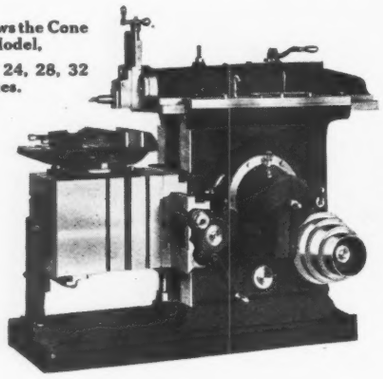
Columbia Shapers

Heavier, More Powerful, More Productive

Generous proportions, high class workmanship and many special features guarantee greater efficiency and ease of operation.

Send for circular 7; study the details of Columbia "Quick Change Feed," "Single Lever for Locking Cross Rail to Column," etc.

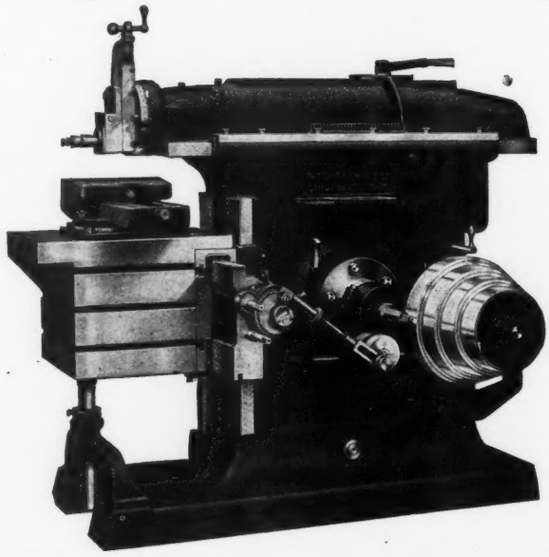
Cut shows the Cone Drive Model, 16, 20, 24, 28, 32 inch sizes.



The Columbia Machine Tool Co.

HAMILTON, OHIO

Shapers Exclusively



Crank Sizes: 12", 14", 16", 20", and 25"—Either Cone Driven or through Speed Box, 28" and 32" B. G. All Geared Single Pulley Drive

The Smith & Mills Company

CINCINNATI **OHIO, U. S. A.**

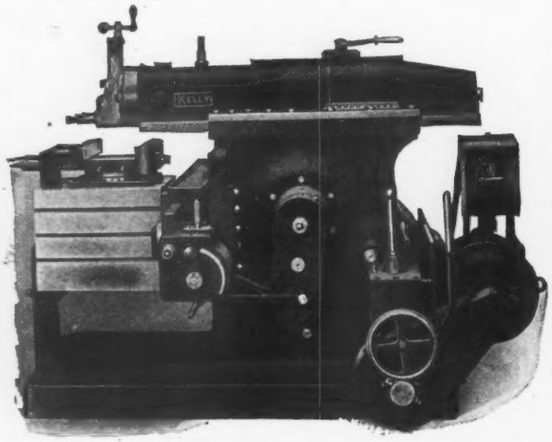
FOREIGN AGENTS: G. & F. Limbourg Freres, Brussels, Belgium; Burton, Griffiths & Co., Ltd., London, England; Van Rietschoten & Houwens, Rotterdam, Holland; Reid Bros. (Johannesburg) Ltd., Johannesburg, South Africa; J. Lambercier & Co., Geneva, Switzerland; Zurich, Switzerland; Y. Lowener, Copenhagen, Denmark; Christiania, Norway; Stockholm, Sweden; H. P. Gregory & Co., Sydney, N. S. W.; Rene Berndes Co., Havana, Cuba; Horne Company, Ltd., Tokyo Japan; Daniele Stussi, Milan, Italy.

24-Inch Back Geared Kelly Crank Shaper

Note these convenient left side controlling devices: starting box—rheostat or drum controller; silent chain or gear drive, clutch and brake attachment for starting or stopping shaper independent of motor.

And, in addition, broad, heavy base, main gear centrally located; stiff heavy ram supported full length of stroke; broad hand scraped bearings, etc. Better have a Kelly catalog before you when choosing a shaper. Sizes 15" Single Geared to 26" Back Geared.

Write for a copy.



THE R. A. KELLY COMPANY

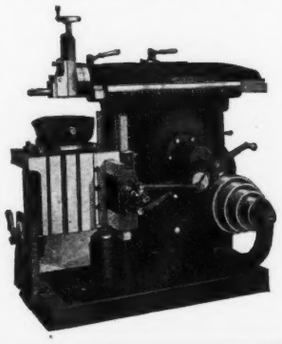
XENIA **OHIO, U. S. A.**

The John Steptoe Company

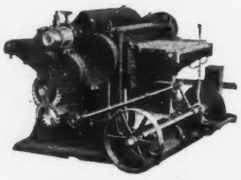
2961 Colerain Avenue **Cincinnati, Ohio, U. S. A.**

When you are in the market for a *Shaper, Milling Machine, Lathe* or *Die Slotter* send for catalogue and prices of

Steptoe's Medium Price Line



Crescent Wood Working Machinery

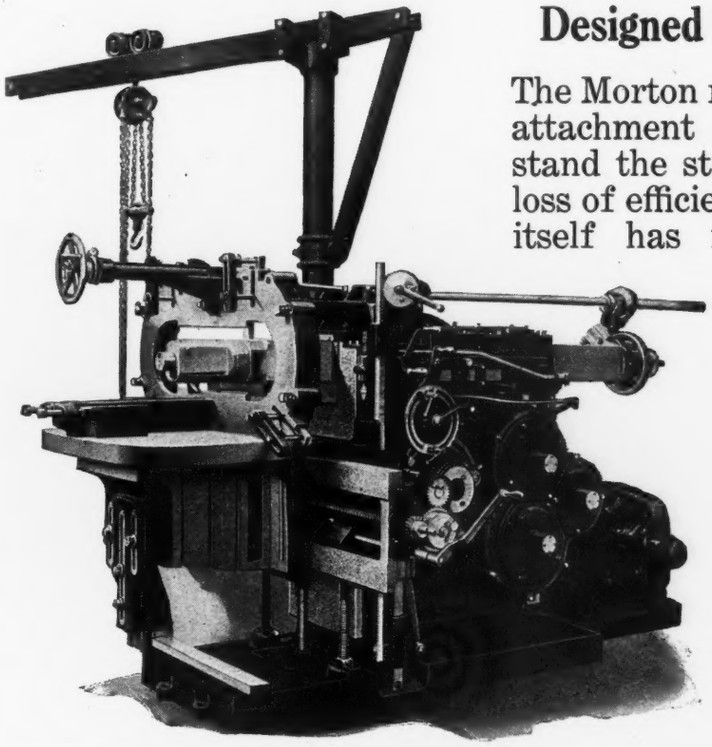


is popular because the machines are durable and always please our customers. The time will come when you will need additional equipment to help you speed up production so you had better get a little ahead of your requirements and ask for catalog today describing band saws, jointers, saw tables, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisels, mortisers, universal wood workers, table cut-off saw.

THE CRESCENT MACHINE CO.

56 MAIN STREET **LEETONIA, OHIO**

The Morton Draw-cut Shaper



Designed for Railroad Shop Service

The Morton railroad shaper with driving box attachment was especially developed to stand the strains of severe service without loss of efficiency. The draw-cut principle in itself has many advantages—it permits deeper, smoother, more accurate cuts than are possible to a push cut shaper—it takes less space, uses less power than a planer with capacity for the same work.

Bulletin 6 D gives interesting details.

Morton Manufacturing Company

Muskegon Heights Michigan, U.S.A.

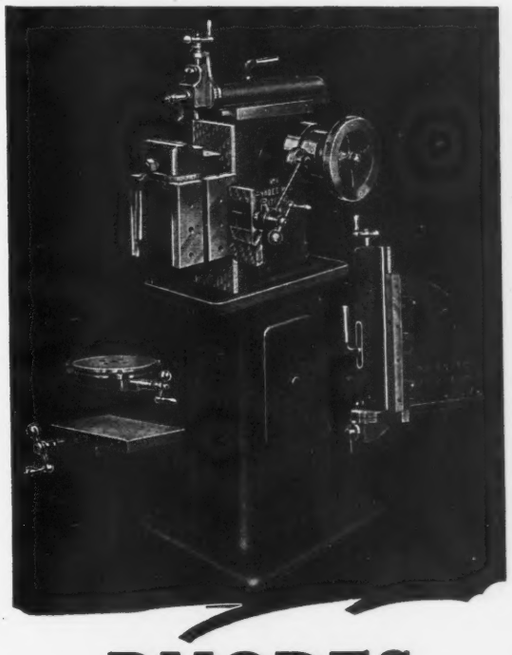
A Point to Remember—

Contract Shops have need for the Rhodes for its flexibility, versatility, speed and ability to keep costs low.

It operates in two planes, horizontal or vertical; is either a 7″ shaper or 3½″ slotter; can be changed from one to the other in a very few minutes; tilts 0° to 10° from vertical; comes equipped with rotary table and vise; etc.

Manufacturing plants find it an economical producer of small accurate work in quantity.

May we tell you all about it? Write for catalog M-22.



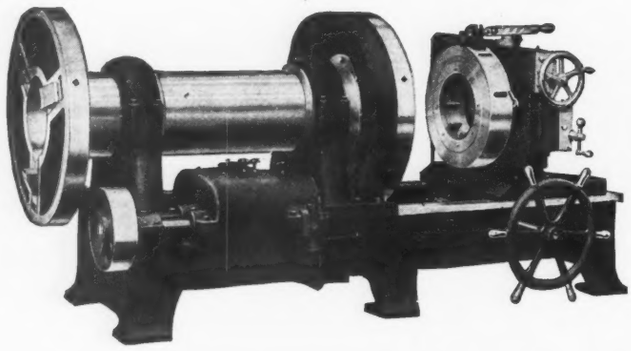
The Rhodes Manufacturing Co.

HARTFORD CONNECTICUT

"You Can Do It With A Rhodes"

RHODES SHAPER and SLOTTER

PEERLESS B&K DUPLEX P·D·Q·C



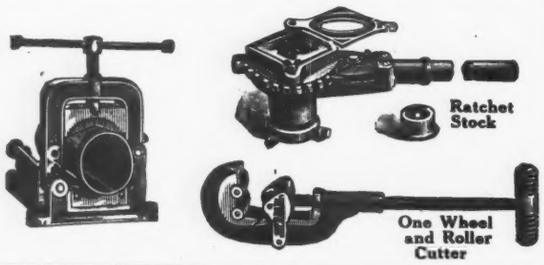
No Frills

Frills have no place on a pipe machine, because they cannot stand the hard knocks. A pipe machine should be a no-frill machine, every part will sooner or later be called upon to buck right up to hard work. The die-head should be equipped with a practical die adjusting device. The cut-off is equally important. The gripping chucks should grip without slipping. The speed changes should be easily obtained. The oiling system should flood the dies and cut-off tool. All these things go to make up a dependable, lasting pipe machine, and are explained fully in our catalog, which will be mailed to you if you want it. Do you want it?

BIGNALL & KEELER MACHINE WORKS, Edwardsville, Ill.

Sales Agents: Manning, Maxwell & Moore, New York, N. Y.

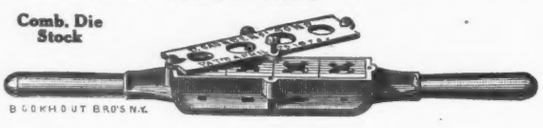
Chicago Philadelphia Boston St. Louis Pittsburgh Cleveland New Haven
Cincinnati Buffalo Syracuse Detroit Milwaukee San Francisco Seattle

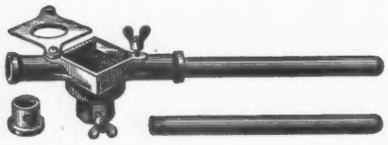


SAUNDERS' TOOLS
Will Stand the Strain

They are the Result of Sixty Years' Practical Experience

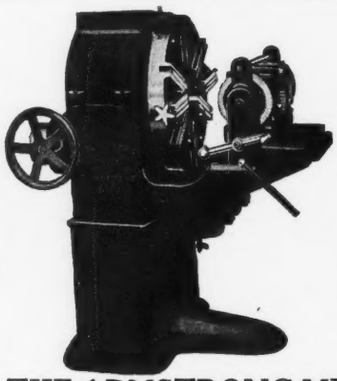
Write for Catalog "P"







D. Saunders' Sons, Inc.
YONKERS, N. Y., U. S. A.



ARMSTRONG No. 3 Pipe Threading Machine

POWER ONLY

Threads Pipe 1 inch to 6 inches right or left.

MANUFACTURED BY
THE ARMSTRONG MFG. COMPANY
BRIDGEPORT, CONN.

Hurlbut, Rogers Cutting-off Machines

It will pay you to investigate the special and patented features of Hurlbut, Rogers Cutting-off Machines.

Write for Catalog

THE HURLBUT, ROGERS MACHINERY CO.
NASHUA, N. H., U. S. A.

Threading Machines

Pipe—"Better Threads at Lower Cost"—**Bolt**

Belt or Motor Driven—Range 1/8" to 24"

Write for our 1923 Catalog

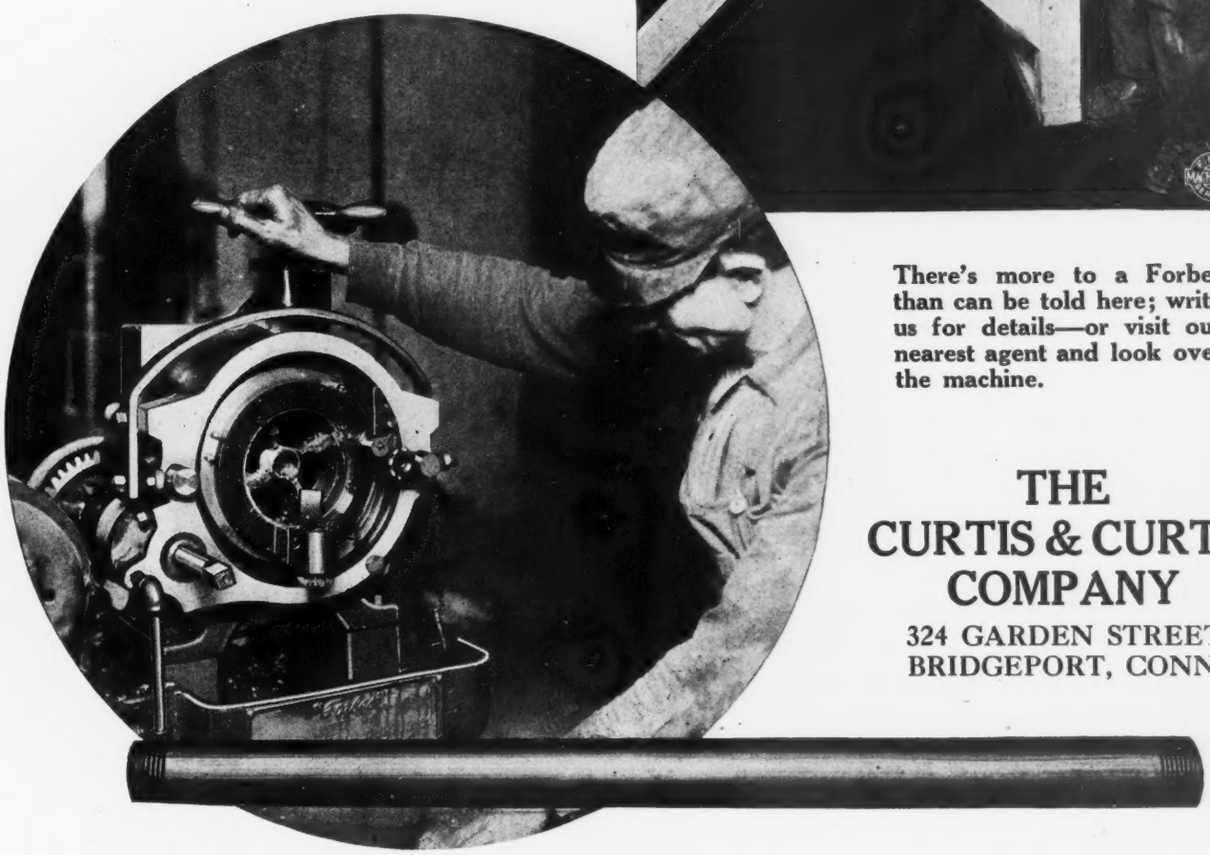
WILLIAMS TOOL CORPORATION
Canadian Plant: Brantford, Ont. ERIE, PENNA.

Trundled from Job to Job in Two Big Buildings

The engineer in charge of maintenance of two large New York factory buildings was easily sold on the Forbes Pipe Threading and Cutting-off Machines by the fact that he had to supply a constant demand for pipe up to 4" in diameter and previously had to do all his threading with stocks and hand threading machines.

The accuracy and convenience of the operating method (by which the *die revolves*, the pipe is stationary) and the "portability" of the machine give the Forbes a great advantage on a job like this. Set up on a bench on wheels and moved from one building to another and from basement to roof as occasion requires, it threads old pipe in position and threads and cuts new sections to meet the need of the moment. It saves time and trouble, improves the quality of the work, it cuts maintenance costs.





There's more to a Forbes than can be told here; write us for details—or visit our nearest agent and look over the machine.

THE CURTIS & CURTIS COMPANY
324 GARDEN STREET
BRIDGEPORT, CONN.

The New FORBES
PIPE THREADING and CUTTING-OFF MACHINES

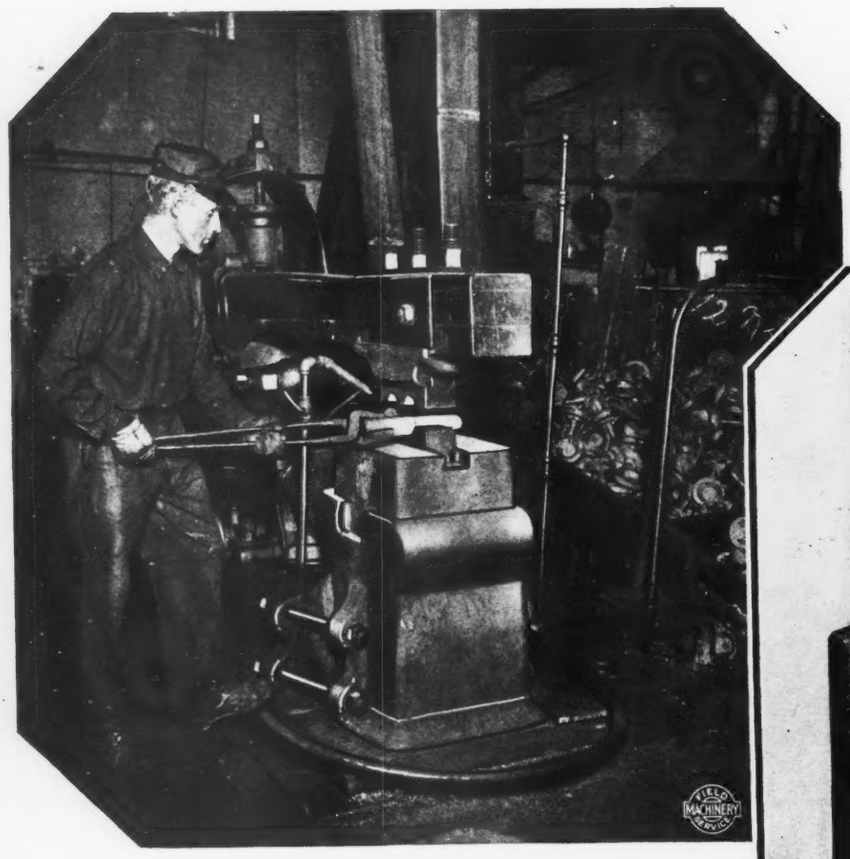
A Bradley Hammer

Draws Them Down—700 in 8 Hours

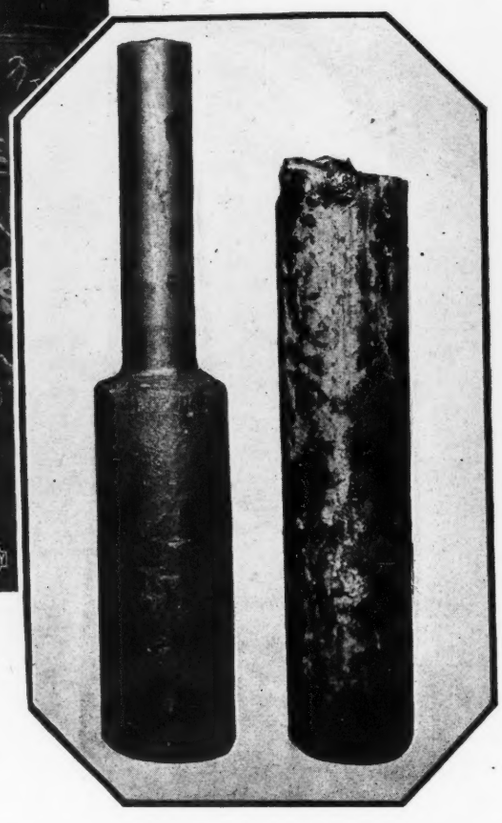
These cylindrical shafts for De Laval Cream Separators are drawn down from steel billets 2½" in diameter to 1¼" in little more than 4 seconds each. A production rate that sets a profitable pace for the upsetting operation which follows.

Two Bradley Hammers were installed by the De Laval Separator Company, (Poughkeepsie, N. Y.) over five years ago; both of them maintain the Bradley tradition of profitable production and low manufacturing costs.

Accurate, powerful, productive and convenient, profitable one man units for drawing down, welding, tool dressing, die work, etc.



"Forge Ahead with a Bradley Hammer"



Details are interesting—if you handle this kind of work write us

C. C. BRADLEY & SON, Inc.

SYRACUSE NEW YORK

ESTABLISHED 1832

HIGH SPEED HAMMER

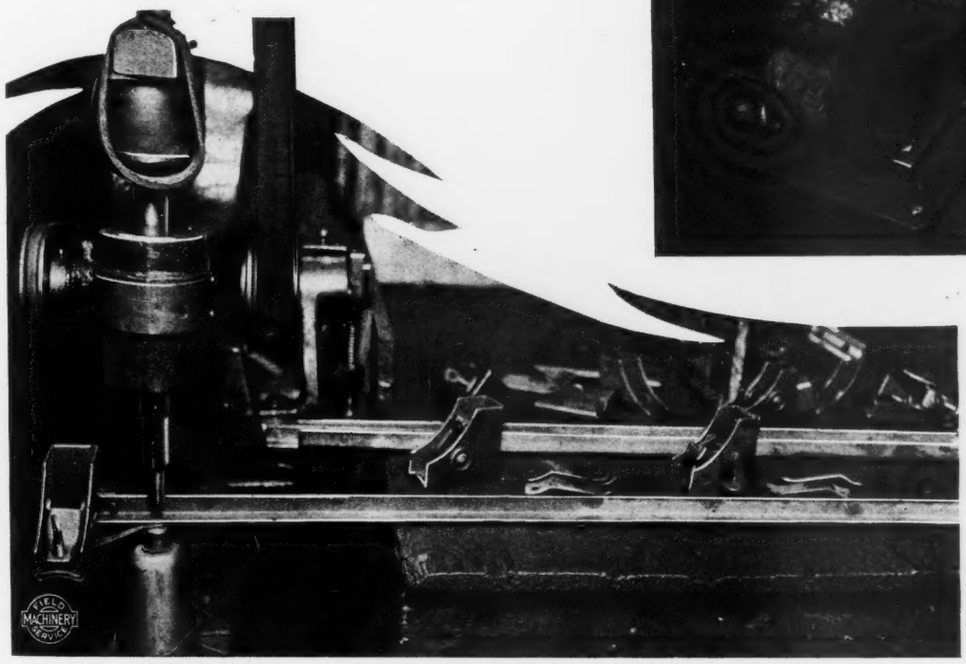
A Metal Bed Manufacturer Discovers Something

The Mersereau Metal Bed Company of Jersey City, N. J., makes about one hundred different kinds of metal beds. In the assembly of the better grades, a patented corner is attached to each of the four corners of the frame.

This is a riveting job, and until one year and a half ago a press was used to head the rivets. Then a High Speed Riveting Hammer was installed—which now does the work better, faster, at lower cost and to the complete satisfaction of this company.

The actual work is riveting corners of 13 gage stock to 1/8" cross angle irons with two 1/4" steel rivets—and one man heads 4000 rivets in a nine-hour day.





If you are riveting, by press or by hand, let us show what a High Speed Riveting Hammer will do for you. Just send a sample of your work.

THE PRINCIPLE IS RIGHT

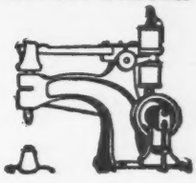


THE HIGH SPEED HAMMER COMPANY, Inc.

ROCHESTER NEW YORK

CHICAGO BRANCH: C. W. Schuchardt, Mgr., 25 South Clinton St. AGENCIES: Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China and Japan Trading Company, Ltd., Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.

THE HAMMER WITH THE HUMAN STROKE

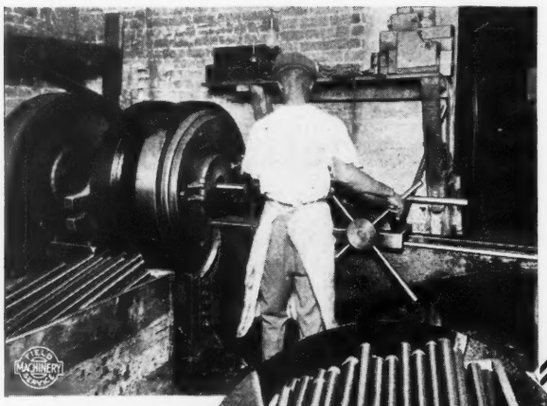


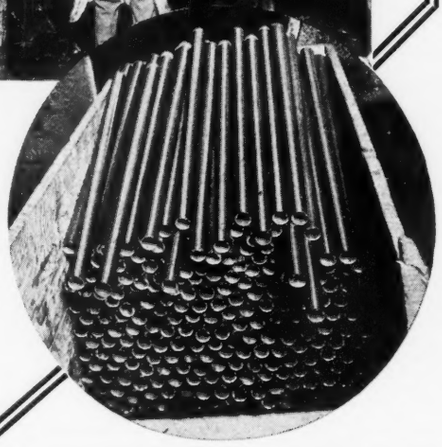
A Good Example of Etna Swaging

The work is reducing 28¾" lengths of No. 19 gage welded steel tubing from 1⅜" to 1⅛" in diameter; **and the output** is one hundred and twenty tubes per hour, two per minute, with one Etna Swaging Machine. Easy work—and satisfactory.

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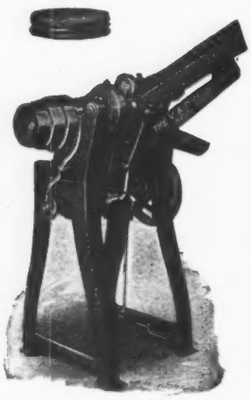
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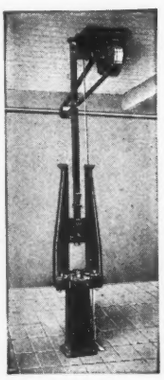
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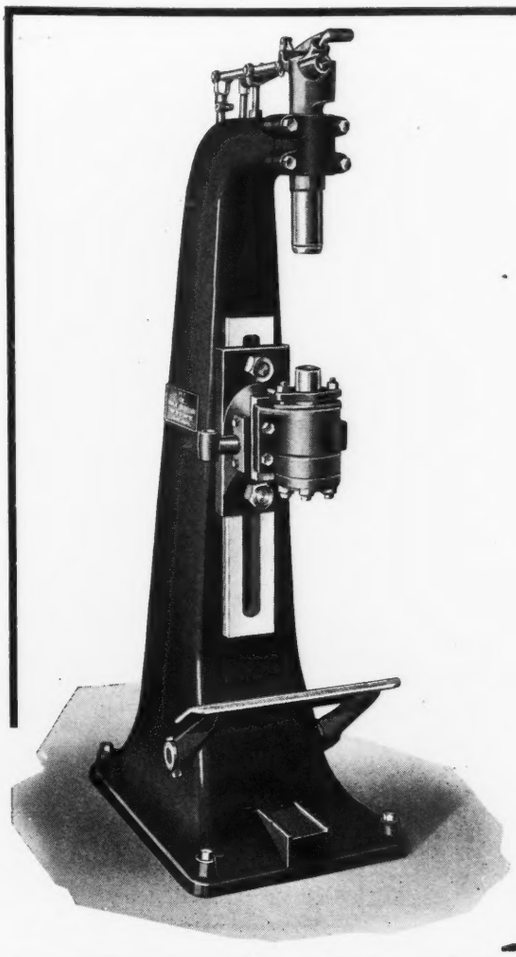
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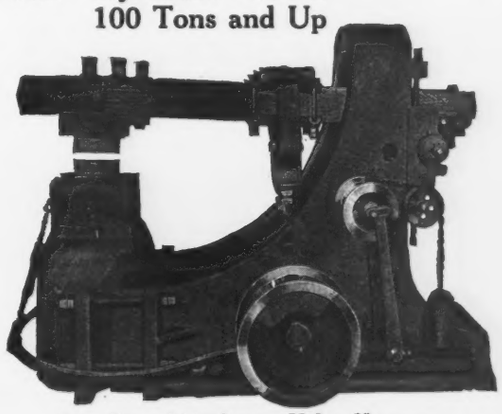
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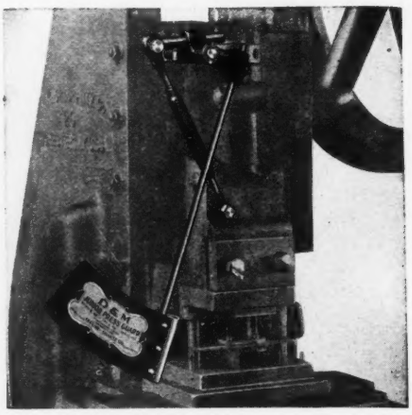
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A Paying Investment if used but an hour a day. 50 to 500 lbs.

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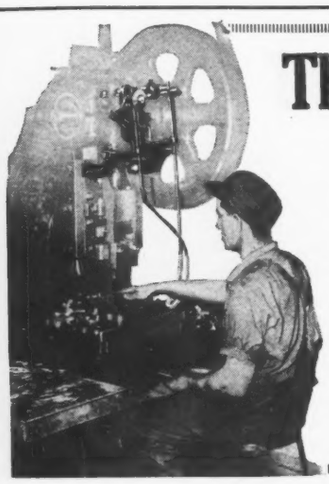
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Automatically sweeps the operator's hand safely aside when in danger.

Protects operator at all times. (Also when the press repeats.) And does NOT retard production.

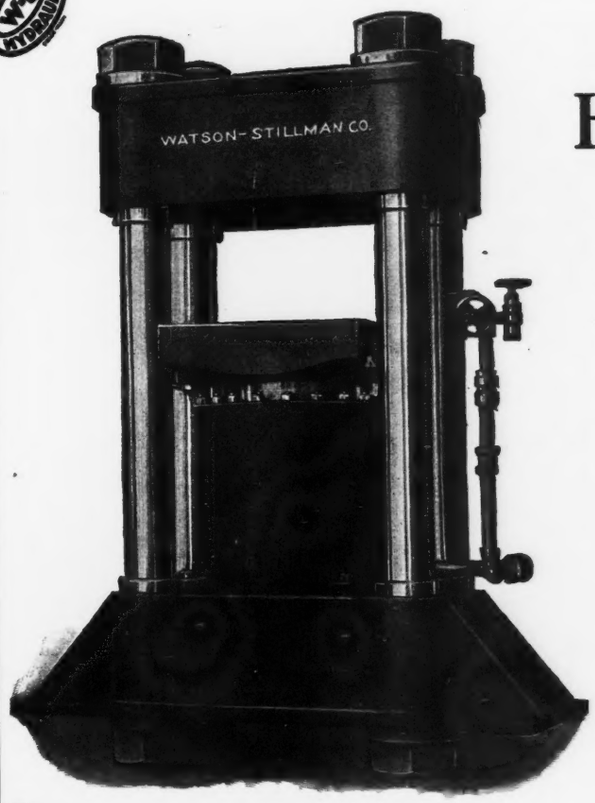
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1800-Ton Hydraulic Die Press

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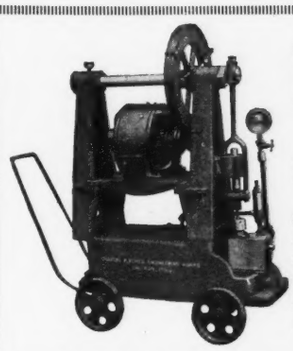
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Riveters, Pumps, Accumulators and all types of Presses
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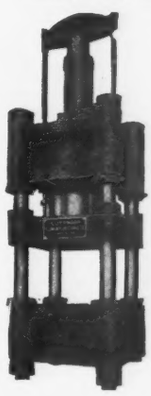
Your forming, forcing, pressing, flanging, bending, broaching, etc It's the easier and more economical way. We furnish complete equipment for pressures from 250 lbs. to 3000 tons. Details on request.

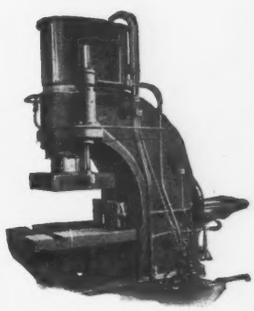


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PRESSES FOR EVERY PURPOSE!



The "Toledo" Horning and Wiring Presses; 10 sizes, 1000 to 13,000 pounds. Detachable Swinging Beds can be fitted to these presses.

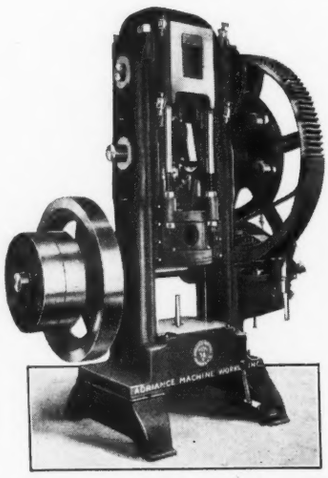
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Combined Drawing and Reducing Presses

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Established 1888—Incorporated 1913
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For Cutting and Forming Metals

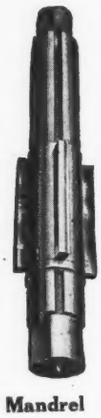


THE FERRACUTE PUNCHING PRESSES have a world-wide reputation for efficient action, correct proportion and beauty of design, the metal being put where it belongs, giving the most strength for the least cost. A number of sizes, with or without gearing.

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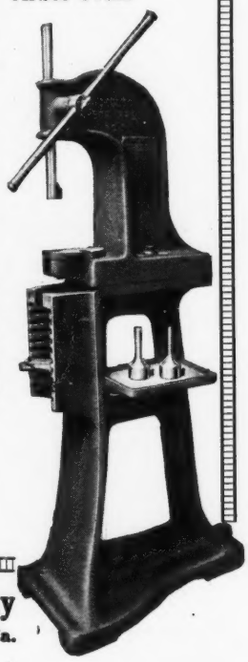


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MANDRELS—Install a set of nine Nicholson Mandrels and save the cost of—and space occupied by—several hundred solid mandrels. You'll be able to fit *every* round or square hole between ½" and 7". No longer is it necessary to turn solid mandrels to size. A light hammer blow tightens or releases a Nicholson Mandrel.

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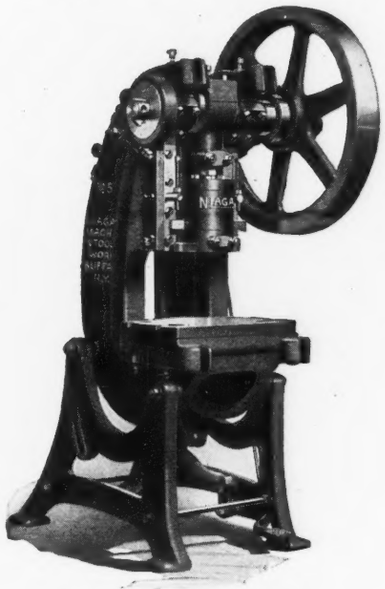


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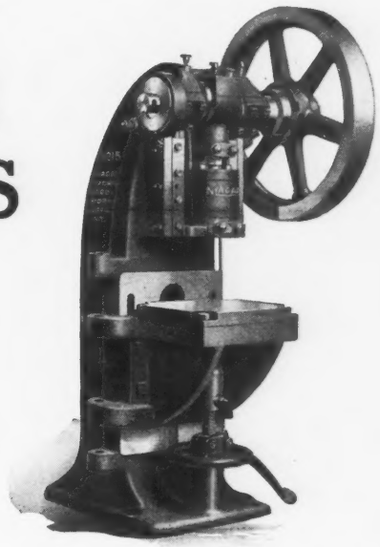
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SHEET METAL WORKING MACHINES & TOOLS

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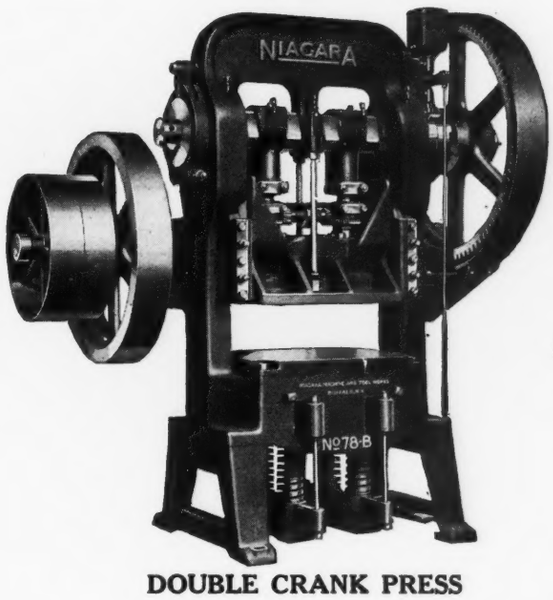


INCLINABLE PRESS



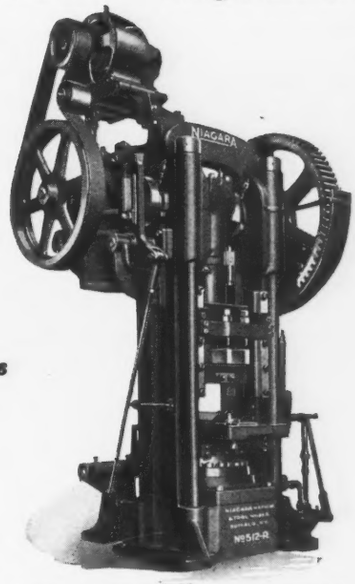
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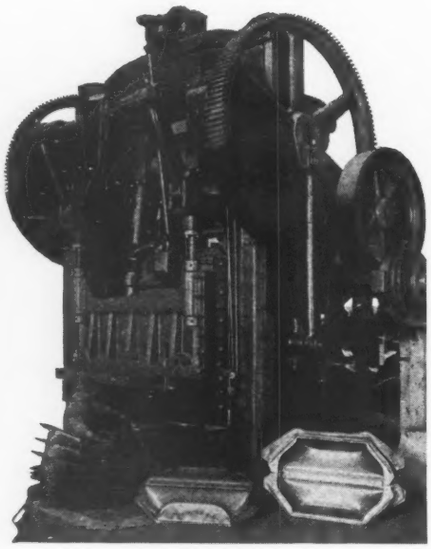


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Drawing Two Cowls

BLISS

BLISS PRESSES are widely used in the manufacture of automobile parts. They have had such an important part in making the pleasure car the light and strong vehicle it is to-day, and the motor truck the powerful and dependable factor in transportation that much need not be said as to their merits in the Automotive Industry.

The BLISS No. 409-D Patented Double Crank Toggle Drawing Press shown is producing two cowls at one time. BLISS Presses economically meet every stamping need in the manufacture of automobile parts.

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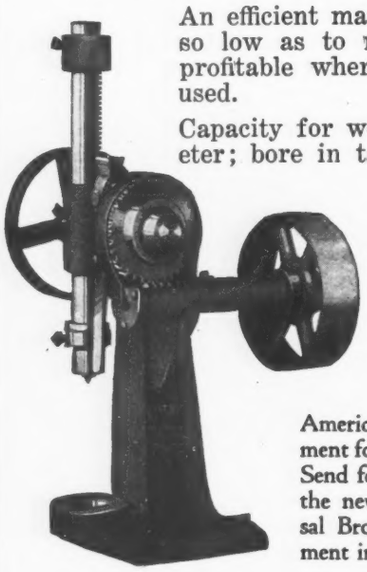
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An efficient machine at a price so low as to make broaching profitable wherever it can be used.

Capacity for work to 6″ diameter; bore in table 2½″ diameter; maximum stroke 14″ developing approximately 2 tons pressure.

Price, $120.00
F. O. B. Ann Arbor

American Broaching Equipment for all classes of work. Send for circular. See also the new American Universal Broach Press advertisement in this issue.

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A Permanent Attachment that equips a Single Action Press to produce Toggle Press jobs.

More Uniform Work with a Saving of 25% to 60% in Production Cost and 40% to 60% in First Cost of Equipment.

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Marquette Die Cushions have made possible many developments in modern methods of metal drawing operations, and most recognized leaders in the trade have long ago adopted Marquette Die Cushions as standard equipment.

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Marquette Tool & Mfg. Co.
321 W. Ohio Street CHICAGO, U.S.A.



A MODERN PLANT FOR THE MANUFACTURE OF

Automatic Feeding Devices for Punch Presses

Also

Reels and Power Winders

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Others have profited by increasing their production. Why not you?

F. J. Littell Machine Co.

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ATLAS Arbor Presses

Up to 40 Tons



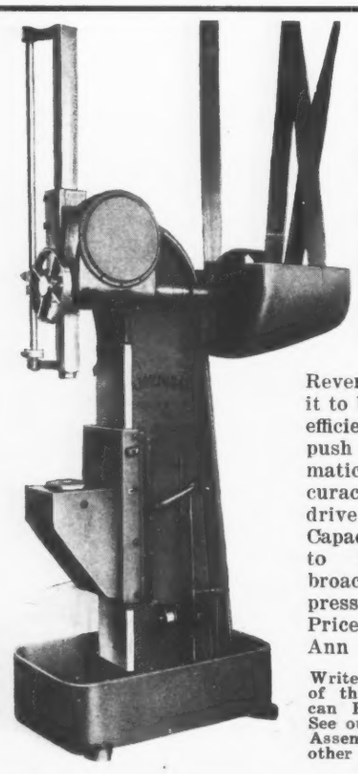
Atlas Arbor and Straightening Presses are powerful, convenient machines with unusual capacity both in the hand and power types.

The cut shows the No. 3 Arbor Press equipped (like all our hand presses) with our patent leverage device which enables the operator to exert enormous pressure with comparative ease; either simple or compound leverage is instantly available.

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New American Universal Broach Press

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Write for further details of this and other American Broaching Equipment. See our Power Broach and Assembling Press on another page of this issue.

American Broach & Machine Co.

Builders of All Types of Broaching Machines and Broaching Tools

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PRESSES AND SHEARS

SHEET METAL WORKING MACHINERY

THE D. H. STOLL COMPANY Inc.

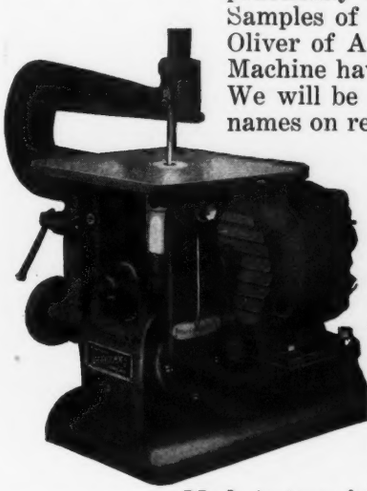
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AN OLIVER OF ADRIAN PRODUCT

"This Oliver is the handiest machine we ever had in the shop."

"We wonder how we ever got along without it. Saves an average of 50% of time on practically every die job."

Samples of what users of the Oliver of Adrian Die Making Machine have to say about it. We will be glad to give their names on request.



Saws out the contour of die blanks, cams, templets, gages and experimental parts and will file and lap them to exact size with any desired clearance in a fraction of the time required to drill, chip and hand file.

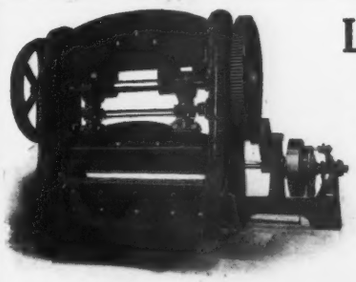
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We carry in stock a large and complete line of saws, files and lapping stones made especially for machine use, guaranteeing maximum output and continuous service.

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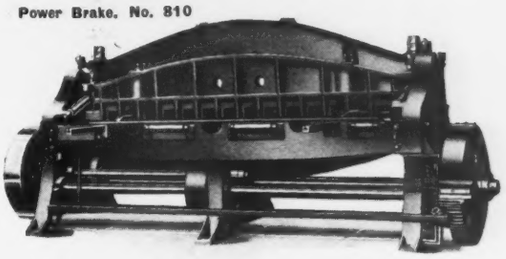
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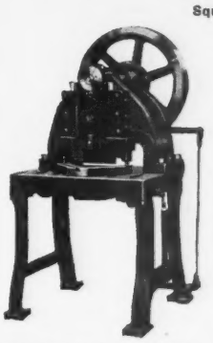
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Power Brake, No. 810



Squaring Shear, No. 310



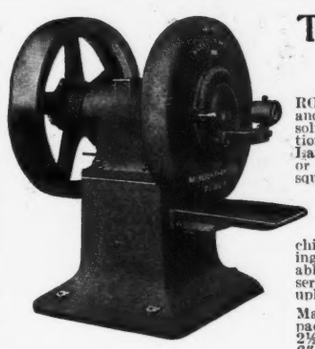
Open Back Press No. 324

We manufacture power brakes, or forming presses and squaring shears in capacities from 16 gauge to ⅜ in., from 4 feet to 12 feet in length. We also manufacture Mitre Presses, special sheet metal machines, forming and mitre dies, and shear blades.

Loy & Nawrath Division

Birmingham Iron Foundry

DERBY CONN.



The Skill is All in the Machine

ROTARY SWAGING is the modern and economical method of forming solid or tubular circular metal sections without waste of stock. The Langelier Swaging Machine reduces or tapers to a circular section, square, round, hexagonal, or similar shapes, hot or cold. We build special swaging equipment for Tungsten Filament Wire.

Our policy is to equip the machines in every detail with work holding and feeding devices that will enable them to give the most efficient service with unskilled help at a low upkeep cost.

Machines built to date, have capacity ranging from a pin point to 2½" diameter on solid stock, and to 6" on tubing.

LMCo. LANGELIER MFG. COMPANY

Arlington, Cranston, R. I., U. S. A.

Buffalo

"Armor Plate" Power Punches, Shears and Bar Cutters

Write for Catalog 51

BUFFALO FORGE COMPANY

Buffalo N. Y.



DO THAT JOB QUICK

of cutting round rods up to ¾" dia. Flats 5/16" thick and under in iron and mild steel, gold, silver, copper, brass, aluminum, card, fibre or hard rubber sheets—use

HERCULES SHEARS and ROD CUTTERS

PLAIN OR COMBINATION



Nos. 1, 2 and 5 W. M. & C. F. TUCKER, Hartford, Conn. Nos. 3 and 4

MERRELL Pipe Threading and Cutting Machinery

Hand or Power Operated

THE MERRELL MFG. COMPANY

15 Curtis Street TOLEDO, OHIO



Patent Pending

Quick Loading Reels For Coiled Stock

S&S

Double Swivel Reels as illustrated are for use with Roll Feeds and Automatic Machines. They insure continuous production.

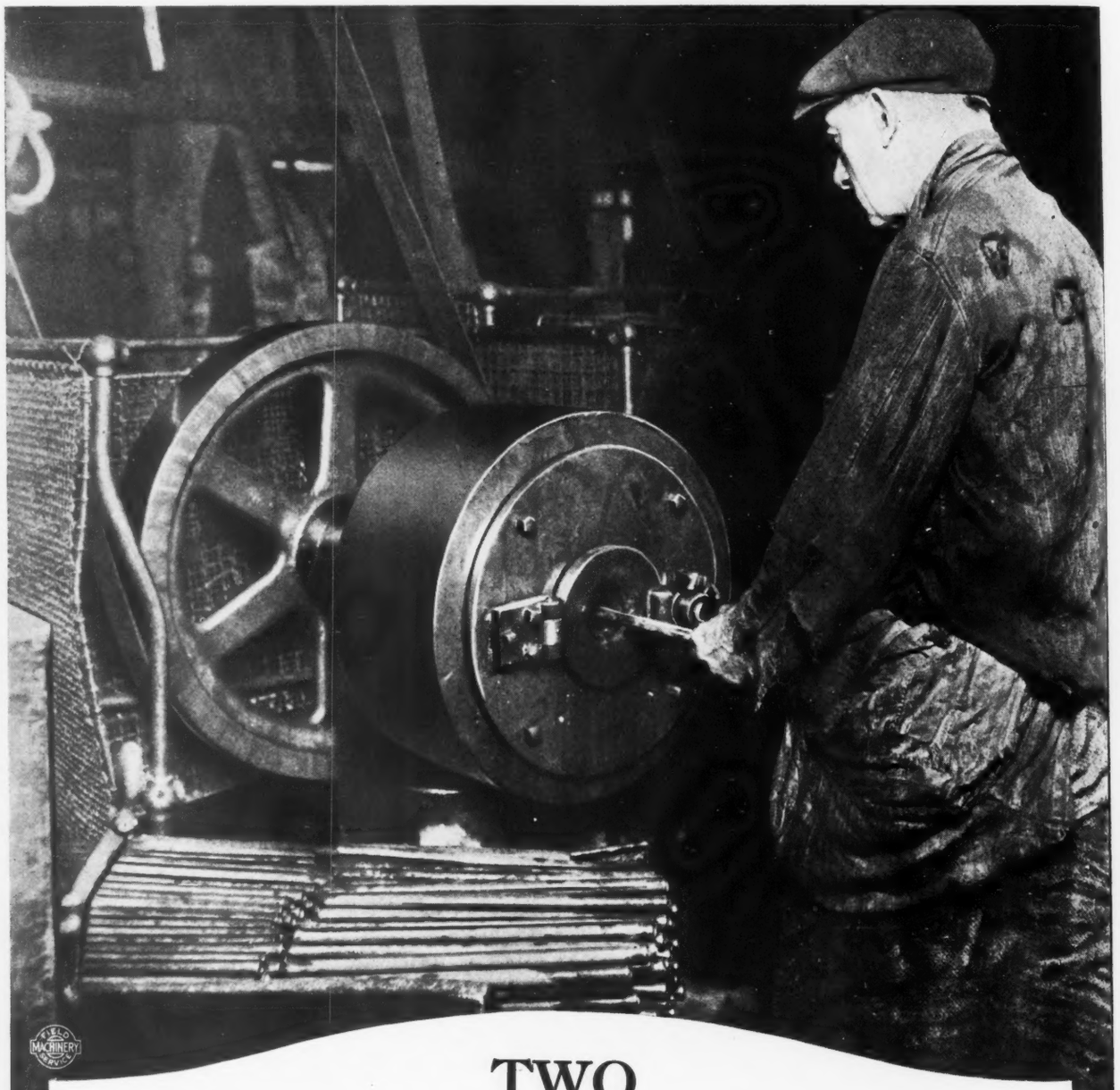
Single Inclinable Reels are for Hand Feeding or for use with Inclined Punch Presses.

Also Other Sizes

Roll Feeds, Dial Feeds, Hopper Feeds, Etc., Stock Reels, Labor Saving Machinery.

S & S Machine Works

4522 W. Lexington St. CHICAGO, ILL.



TWO
DAYTON SWAGING MACHINES
with a Total of a Quarter Century's Service

Fifteen and ten years respectively are the service records of the two Dayton Swaging Machines at the H. P. Snyder Manufacturing Company, Little Falls, N. Y.,—and the only repairs have been rebushing one main shaft bearing. These machines are used for reducing and tapering tubing for bicycles and velocipedes. Tubing is reduced from 7/8" to 11/16" diameter at the rate of 20 feet per minute. Hollow stock for the front fork sides is tapered from 1" to 5/8" on a length of 12" (two operations required) at an average rate of 1600 pieces in five hours.

Profitable production, long service, low costs—make Dayton Swaging Machines popular on all kinds of work. Let us tell you about them.

THE TORRINGTON COMPANY—Excelsior Plant—57 Field St., Torrington, Conn.

SUCCESSORS TO EXCELSIOR NEEDLE CO.

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agent for France, Italy, Belgium, Spain, Portugal and Switzerland.

Kobert

Electric Riveting

Our heading stands for two things, an Electric Riveting Machine and a production method. These are the result of ten or more years of hard work starting in the "pole line" hardware business. Here's the story—

A line of fittings, fabricated from steel, was designed to compete with the malleable cast parts then commonly used. All went well until it was discovered that some of the cold-riveted parts wouldn't stay together; they either worked loose or fell apart and nobody could tell *when* it would happen. Cold riveting was a total failure on this work but something *had* to be done. Hot riveting was obviously the thing but either the design of the parts or size of rivet barred its successful employment. Riveting of some kind was necessary, but what? Everything was tried. Stuck, absolutely stuck! That is, until a transformer was rigged up so close to the riveting press that parts could be heated electrically and flipped into place before the rivet could cool. The result of this was pretty good but the method unsatisfactory. Thought, work, experiments followed—then the transformer was made a part of the riveting press and rivets heated *after* assembling.

The next step was the construction of the "dual head," a device in which one unit was designed and built *solely* for carrying electric current to the rivet. When the proper temperature was reached, the operator could shift to the second unit and operate it to set the hot rivet. The dual head was a *very* important development.

The automatic duel head, safety release and other improvements came later. After a number of machines had been in successful operation on our own work for some months, we built a few for people who had asked for them. We watched these machines in operation, made some improvements, built some more machines, finally we had the present Kobert Electric Riveting Machine. This type machine has been in successful operation in a number of different industries for more than 5 years.

There you are. Haven't been able to tell the *whole* story or even show a picture, but you can easily see a Kobert Electric Riveter in operation—ask any of our dealers. At the same time get the Green Book, it's worth reading.

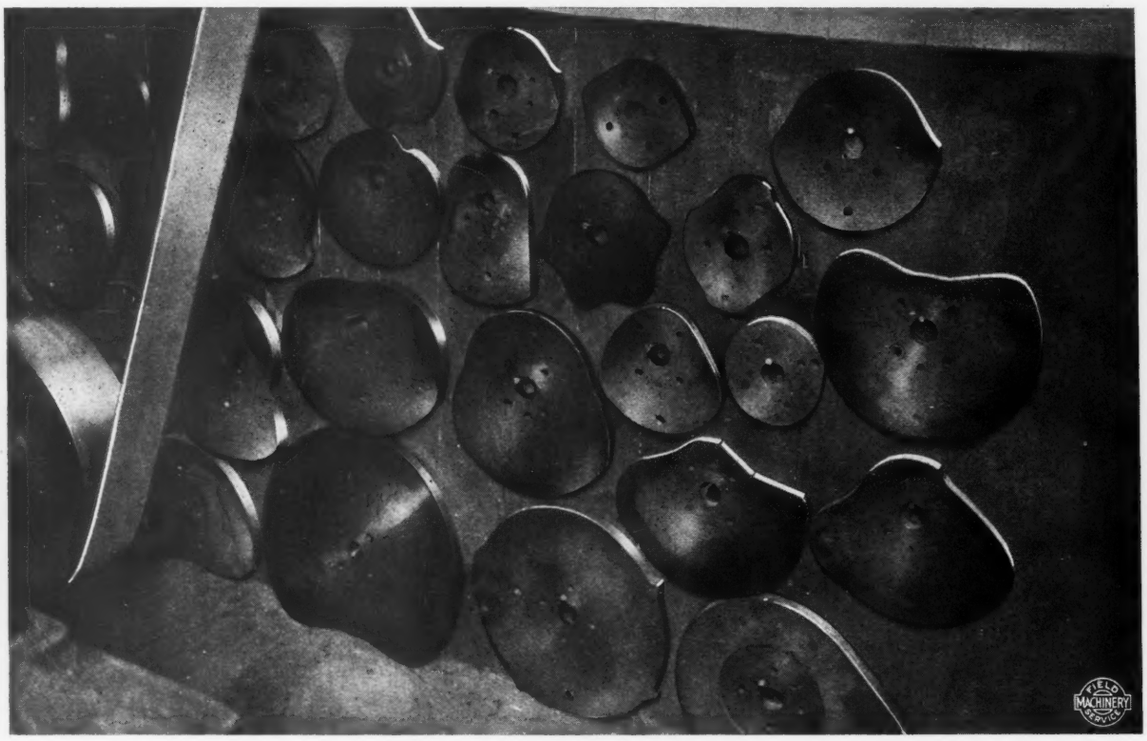
Kobert Machine Company, Inc.

98 Union St., Worcester, Mass.

Chicago:
Neff, Kohlbush & Bissell

Philadelphia:
Swind Machinery Co.

Detroit, Pittsburgh, Cleveland, Cincinnati:
Motch & Merryweather Machinery Co.



Master Cams That Take Their Turn on the Rowbottom Milling Machine

Automatic canning machinery requires many cams of many kinds and this group of "masters" shows only a few of the patterns in use in a big plant building this type of machinery.

The variety is great enough, however, to give some idea of the work done here on the Rowbottom Cam Milling Machine, for not only are all the cams cut on the Rowbottom, but the master cams themselves are accurately and economically produced on the same machine.

The range and simplicity of Rowbottom Cam Milling Machines transform the manufacture of cams in quantity, from a difficult and expensive to an extremely satisfactory and highly profitable class of work.

"Rowbottom for cams" is a good motto to tie to, whether you use Rowbottom Cam Milling Machines in your own plant or let us handle your work in our contract department.

Details of the machines, estimates on special work, on request.

THE ROWBOTTOM MACHINE COMPANY

WATERBURY, CONN., U. S. A.

Factory: WATERVILLE, CONN.

Rowbottom for Cams

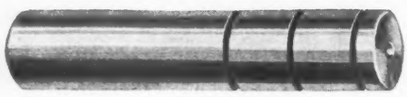
Special Equipment Section

Special Machinery
Screw Machine Products
Drop Forgings
Fixtures
Tools, Dies, Jigs
Castings
Die Castings
Stampings
Contract Work
and
Designing

Leader Pins—Bushings—Dowel Pins

Hardened and Ground, Carried in Stock

Leader Pins

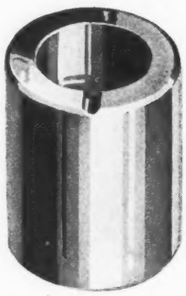


Made of steel, carbonized, hardened, ground and lapped on centers to ± .0002″ of dia.

In complete range of sizes from ½″ x 4″ to 1½ x 9″. Immediate shipment from stock.

Larger sizes on order.

Bushings



Danly Standard Straight, Shoulder and extra long bushings in wide range of sizes.

Dowel Pins



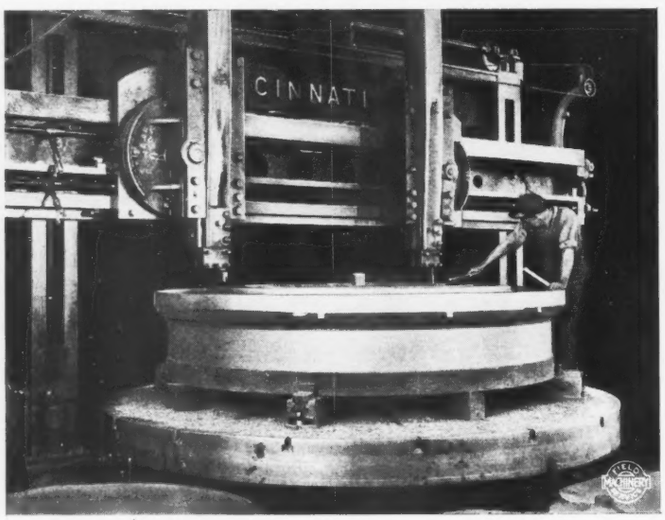
Hardened, drawn and accurately ground to ± .0001″ of diameters.

Also stocked .001″ over size. In stock from 3/16″ x ⅞″ to ½″ x 2¾″. Boxed and labeled; dozen to box.

DANLY MACHINE SPECIALTIES

(*Division of Ludwig & Ludwig*)

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SPECIAL MACHINERY

Builders for Production

Behind the Scenes

A complete installation of machines of the class and quality of the big boring mill here shown enables us to build any kind of standard or special machines up to 100 tons economically and efficiently in any quantity.

"Building for production" means building machines of a class and character to advance the standards of industry, at a price that is only made possible by expert service and efficient equipment.

We are ready to discuss your project, advise on its execution, estimate on the work and guarantee satisfaction. Come and see us when you're out this way.

THE KENT-OWENS MACHINE CO., Toledo, Ohio, U.S.A.



To cut production costs, run your business under two roofs— yours and ours

OUR specialty is tooling equipment for special work; Jigs, Dies, Gages and Fixtures, also Machines and Special Tools. We specialize in one direction for the same reason Henry Ford does— to get production. And we get production with special equipment—tools made for the work.

Standard equipment won't give you production on special work. Why not, therefore, put your tool-room under our roof? We can save money for you through our wide experience in designing and building special equipment; we have in many instances doubled and trebled production.

Send samples or blueprints of your product; state equipment used; tell us your needs. If we can increase production and lower costs by special equipment we'll tell you how—or return sample with a frank statement that we can't improve on your own methods.

The Steel Products Engineering Co.

SPRINGFIELD, OHIO, U. S. A.

REPRESENTATIVES: Hess-Schenck Company, Cleveland, Ohio. J. L. Lucas & Son, Inc., Bridgeport, Conn. Haberkorn & Wood, Detroit, Mich. McCoy-Brandt Machinery Co., Pittsburgh, Pa. Scott-Bansbach Machinery Co., Chicago, Ill. M. J. Walsh Machinery Co., Milwaukee, Wis. Buckner-Woodard Co., Seattle, Wash. Simmons Machine Tool Corporation, Buffalo, N. Y. Triplex Mch. Tool Corp., 50 Church St., New York, N. Y.

DU PONT ENGINEERING COMPANY

Only One Standard

A degree of quality that will assure absolute satisfaction is our only standard in producing every job we do.

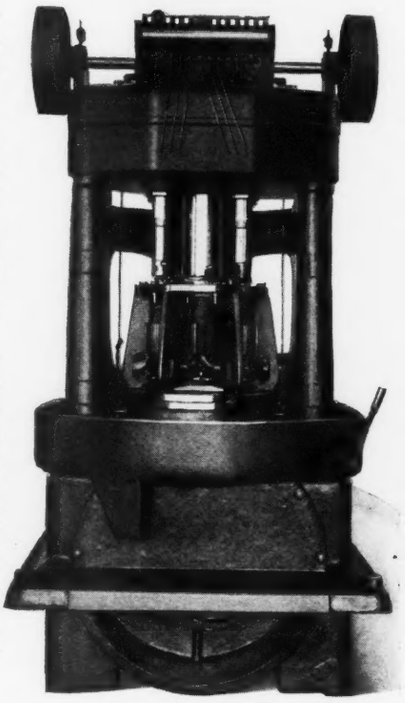
Complete equipment, experienced workmen, and capable supervision permit us to handle your machinery or machine parts, castings, patterns or special apparatus requirements quickly, economically and satisfactorily.

Can we serve you? We will gladly estimate on that job you have in mind.

DU PONT ENGINEERING COMPANY

WILMINGTON SHOPS
Wilmington, Del.

Better Work in 85% Less Time



Details are confidential, but a glance will show you there are 5 working and 1 loading positions. The machine cut machining time from 10 to 1½ minutes per piece *and* improved the quality of the product.

No, Mr. Manufacturer, this case is not exceptional. We've done even better on occasion and increases of 25 to 80% are every day occurrences.

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Manufacturers' Consulting Engineers

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Stenton Avenue and Louden Street
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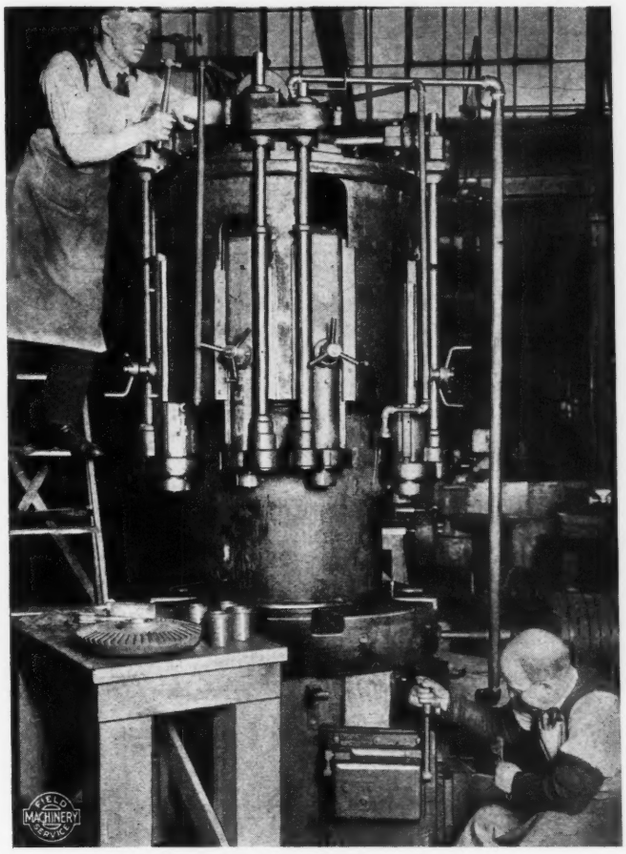
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JIGS, FIXTURES, DIES, GAGES AND SPECIAL MACHINES
SEND FOR FREE ILLUSTRATED PROSPECTUS
MEHL MACHINE TOOL & DIE CO.
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30 Minutes from New York City ROSELLE, NEW JERSEY

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We can give you excellent service, making and designing Dies, Fixtures, Special Machines, Jigs, Small Tools, Gauges and Stampings.
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A Card will bring our Catalogue

Designers and Builders of Special Machinery, Dies and Tools.
Let us figure on your requirements.

THE BUDD-RANNEY ENGINEERING COMPANY
Columbus, Ohio



Do You Drill Connecting Rods?

You have heard of continuous milling operations. This special machine has been designed and built by The Columbus Die, Tool & Machine Company for continuous drilling operations, drilling both ends of a connecting rod simultaneously.

But that's only one example of where a special machine designed and built in our plant has effected a noteworthy saving in production costs. Tell us about your problems and ask for suggestions on special machinery for speeding up rates of production.

The Columbus Die, Tool & Machine Company
COLUMBUS OHIO

A MODERN well equipped Boiler, Machine and Blacksmith Shop enables us to build many kinds of special machinery.

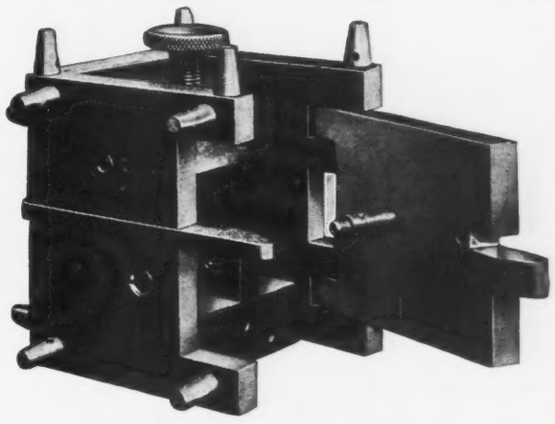
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We have the reputation for producing tools that are foolproof, easy to manipulate and give the largest possible production.
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Special Machinery made to your blueprints.
Contract work—large or small quantities.
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Need overflow capacity for your tool-room? Not enough men to handle the work—satisfactorily—on time?

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Reliance Die & Stamping Co.
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BETTER FORGINGS

J & J Forgings Won't Swell Your Scrap Heap

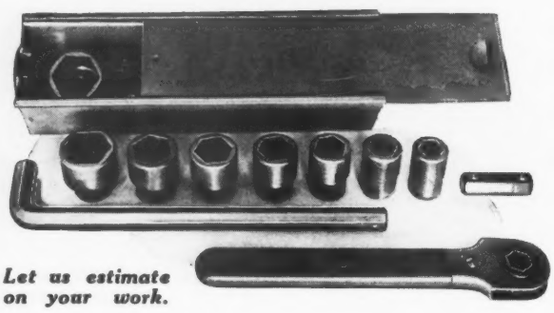
Nothing more annoying than to pay for tons of high grade forgings and see 20 to 25% of the metal go to the scrap heap. Nothing like that occurs in shops that standardize on J & J "Better" Forgings. They're forged so close to finish dimensions that finish machining is all that is necessary—a clear saving of machining time, trouble and metal, which is best appreciated when experienced in your own shop.

Try them on your next order.

Spindles
Arbors
Gear Blanks
Weldless Rings
Engine Shafts
Axles, Etc.

THE JOHNSTON & JENNINGS CO.
INCORPORATED 1894
Addison Road and Lake Shore R. R. Tracks
CLEVELAND, OHIO, U. S. A.

Efficient Contract Manufacturing Shows Profit All Through



Let us estimate on your work.

Here's a good example of what we mean. This is the "Fit-Em-All" Socket Wrench; the retail price is $2.50. Now consider, that the retailer, the designer (our customer) and we, the *manufacturers*, all find it profitable to make and sell these tools.

The answer? Manufacturing efficiency. The kind that is absolutely necessary in a successful contract shop.

We offer a complete contract manufacturing service, design, development, model making and building of special machines. Precision jig, fixture, tool and die manufacturing. Special stampings.

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The World's Headquarters For Sheet Metal Products

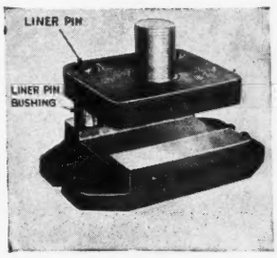
We operate large Iron and Steel Foundries, have a complete Pattern Shop, and a Machine Department with a large range for both small and large work.

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Engineers, Machinists—Iron and Steel Founders
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Do You Want Real Service? **Dies, Tools**

Special Machinery—Small Stampings. Production Work on Machine Parts. Real Service at the Right Price.
With fine equipment and a splendid organization we guarantee satisfaction. Let us quote you on your requirements.
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COLUMBUS, OHIO

WHETHER you want help or want work—want to buy a book, a tool or a machine—in fact, whatever small bit of advertising you are thinking about, send your order to MACHINERY'S Classified or Want Section.



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STANDARD PUNCH and DIE SETS

Patented U. S. Patent Office.

Rear or diagonal steel liner pins and bushings insure accuracy on all press operations.

The strength and rigidity of these sets enable us to recommend them for heavy duty service with assurance that they will outlast sets of lighter construction.

All sizes in stock for immediate delivery.

Our product is our best advertisement.
Our service department will advise economical size.

DIE SETS PUNCH TOOLS

DIAMANT TOOL & MFG. CO., Inc.
95 Runyon Street NEWARK, N. J.

Safeguard Your Reputation with Dyson Forgings

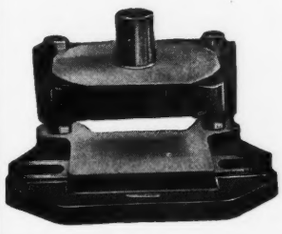
Be as careful of the quality of the steel going into your product as you are of the machining operations.

For a given size, a Dyson Forging is stronger than ordinary steel; for a given strength you may use less material.

Dyson Forgings—anything from a 3″ nut to a 5-ton shaft. Rough machined. Heat-treated. Get an estimate.

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CLEVELAND OHIO

U. S. SUB PRESSES



Guaranteed to align perfectly

Best gray iron castings, carefully machined and parallel; liner pins are tool steel, hardened and ground. Produced in quantity, sold direct, cost less to buy than for you to make. Before experimenting, send for list of sizes and prices.

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FREDERIC C. DANNEMAN
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Sole Distributor
for Greater New York
Phone, Franklin 5624
Carries stock for immediate delivery

Flat Die Forgings to Any Blue Print or Any Grade of Steel

THE MACHINERY FORGING COMPANY
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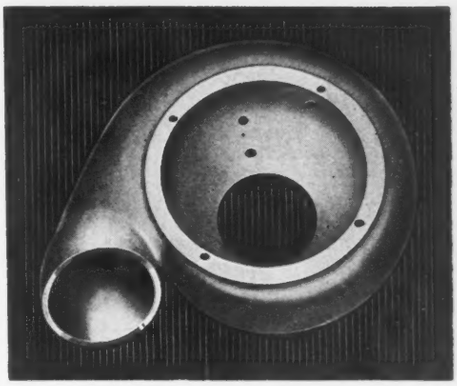
Do the Machines You Build Require

HOLLOW BORED FORGINGS and STEEL SHAFTS?

If so, it may pay you to submit your blueprints and let us quote on such items as Lathe Spindles, Piston Rods, Rams, Clutch Shafts, etc.

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The World's Largest Producer of DIE-CASTINGS



Doehler Die-Cast Aluminum Vacuum Cleaner Housing

The purchase of Doehler Die-Castings is not merely the purchase of a quantity of finished metal products.

It is also an investment in the reputation, the resources, the experience, the service, of the Doehler organization—the largest producers of die-castings in the world.

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DOEHLER DIE-CASTING CO.
BROOKLYN. N.Y.
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WHY NOT USE DIE CASTINGS?



Ideal also for Bearings, Gears, Cams, Ratchets, etc.

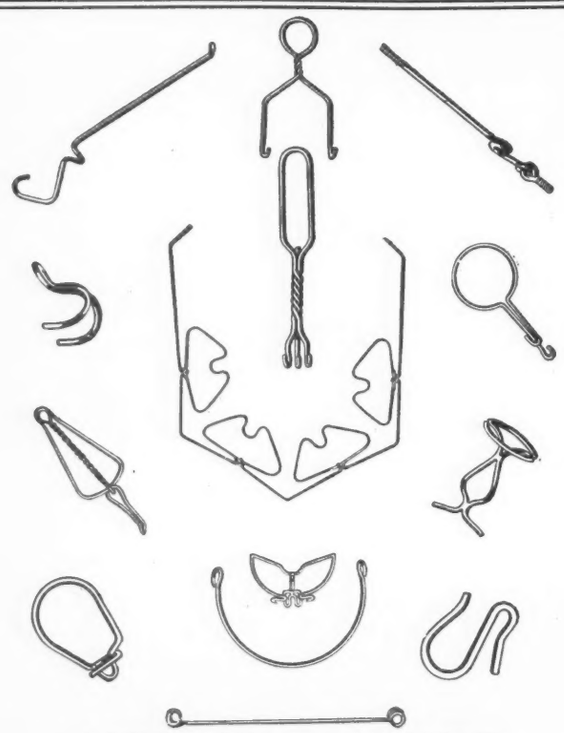
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As compared to sand castings Die Castings are stronger and eliminate finish machining; as a substitute for machining intricate interchangeable parts they save the expense of jigs, fixtures, etc., and of individual inspection for accuracy.

Many manufacturers of automobiles, telephones, typewriters, mechanical actions, precision instruments, etc., endorse Phoenix Die Castings. Why not try them on some of your expensive parts?

PHOENIX DIE CASTING CO.

Established 1907 **BUFFALO, N. Y.**



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Odd and unusual wire bends, or twists, metal ribbon products made on automatic machines in shorter time than you'd believe possible and at reasonable prices. Let us estimate on your work.

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Something Special?

If you have an idea to be developed, a mechanism perfected, unusual tools to be made, a machine built—there are concerns who specialize in doing just these things.

MACHINERY'S Special Equipment Section is designed to bring together purchasers and makers of products of special nature. It groups the advertisements of manufacturers who have a service to offer rather than standard tools or machines.

Look them up in MACHINERY.

Guaranteed Die Castings
Low Price
Quick Delivery
By a New Method
REPUBLIC DIE CASTING CO., INC.
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LIGHT STAMPINGS

of all kinds. We can also furnish Dies and Tools. Our low overhead insures a reasonable price.

Send Samples or Blueprints for estimate.

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COLUMBUS, OHIO

Brass, Bronze and Aluminum
CASTINGS
TIFFIN BRASS & BRONZE CO.
TIFFIN, OHIO

FRANKLIN DIE-CASTINGS



Make Easy Work of Castings Difficult to Machine

We think that anyone who studies the drawing of this cream separator part will agree with us that it was difficult to machine. That is why die-castings were later specified. And this part represents only one of many problems that Franklin Die-Castings have solved.

We originated the die-casting process in 1892 and for over thirty years have been reducing costs and simplifying output in many fields of industry.

We cast in aluminum tin, lead and zinc base alloys. Quotations furnished on receipt of samples or blueprints.

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and "Die-Casting."

FRANKLIN DIE-CASTING CORPORATION
Gifford and Magnolia Streets
Syracuse, N. Y.



Since 1919

SUPERCAST
QUALITY
DIE CASTINGS

Dependable SUPER CAST Die Castings

THE SUPERIOR DIE CASTING CO.
CLEVELAND

DIE CASTINGS

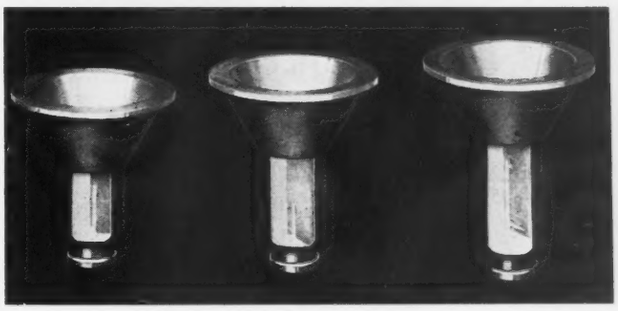
Prompt delivery guaranteed. Send samples, blueprints or sketches for estimates.

MT. VERNON DIE CASTING CORPORATION
MOUNT VERNON, N. Y.

ELECTRIC STEEL CASTINGS

Farrell-Cheek Steel Foundry Co.
SANDUSKY, OHIO

ALUMINUM CREAM SEPARATOR DISTRIBUTORS MADE BY THE PERMANENT MOULD PROCESS



(The distributor of a cream separator revolves at a very high rate of speed. It must be strong to withstand this speed and perfectly balanced. Also, it must be free from porous spots where milk can collect and sour.

Permanent Mould Aluminum Castings are *guaranteed* to be free from porous spots or blow-holes. They are stronger than either pressure aluminum die-castings or aluminum sand castings. This manufacturer of cream separators naturally chose to have his distributor parts made as Permanent Mould Aluminum Castings in preference to porous aluminum die-castings. Incidentally we were able to save him forty per cent of the weight of the distributor as formerly purchased in a sand casting and give him a casting as accurate as the best pressure aluminum die-casting he could buy.

You doubtless have parts that can be made more economically as Permanent Mould Aluminum Castings without sacrificing strength. Send sample or blueprint for quotation or write for further information and sample castings.

The Bronzo Alumina Corporation
Permanent Mould Aluminum Castings
BUFFALO, N. Y.

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WHY NOT USE DIE CASTINGS?



Ideal also for Bearings, Gears, Cams, Ratchets, etc.

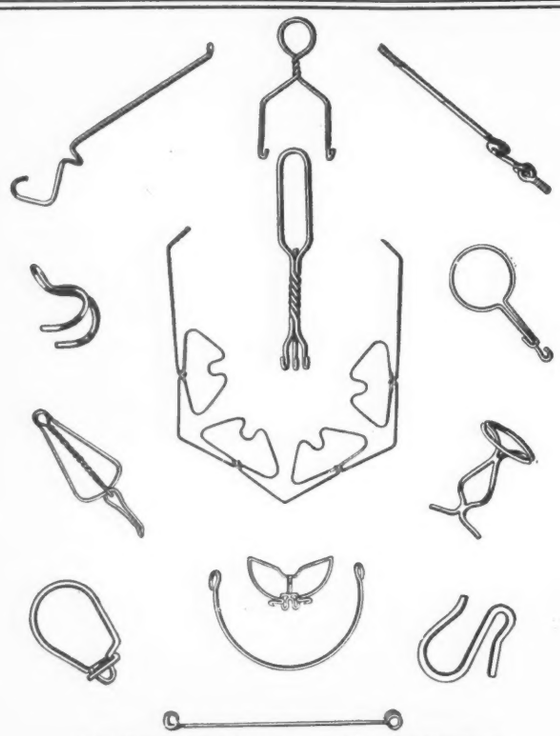
As compared to sand castings Die Castings are stronger and eliminate finish machining; as a substitute for machining intricate interchangeable parts they save the expense of jigs, fixtures, etc., and of individual inspection for accuracy.

Many manufacturers of automobiles, telephones, typewriters, mechanical actions, precision instruments, etc., endorse Phoenix Die Castings. Why not try them on some of your expensive parts?

Estimates from Samples or Prints

PHOENIX DIE CASTING CO.

Established 1907 **BUFFALO, N. Y.**



ANYTHING IN WIRE

Odd and unusual wire bends, or twists, metal ribbon products made on automatic machines in shorter time than you'd believe possible and at reasonable prices. Let us estimate on your work.

Eastern Tool & Manufacturing Company

135 Bloomfield Ave. BLOOMFIELD, N. J.

Something Special?

If you have an idea to be developed, a mechanism perfected, unusual tools to be made, a machine built—there are concerns who specialize in doing just these things.

MACHINERY'S Special Equipment Section is designed to bring together purchasers and makers of products of special nature. It groups the advertisements of manufacturers who have a service to offer rather than standard tools or machines.

Look them up in MACHINERY.

Guaranteed Die Castings
Low Price
Quick Delivery
By a New Method
REPUBLIC DIE CASTING CO., INC.
128-138 MOTT ST., NEW YORK CITY

LIGHT STAMPINGS

of all kinds. We can also furnish Dies and Tools. Our low overhead insures a reasonable price.
Send Samples or Blueprints for estimate.

THE SAFETY WIRE GAS GLOBE CO.
COLUMBUS, OHIO

Brass, Bronze and Aluminum
CASTINGS
TIFFIN BRASS & BRONZE CO.
TIFFIN, OHIO

FRANKLIN DIE-CASTINGS



Make Easy Work of Castings Difficult to Machine

We think that anyone who studies the drawing of this cream separator part will agree with us that it was difficult to machine. That is why die-castings were later specified. And this part represents only one of many problems that Franklin Die-Castings have solved.

We originated the die-casting process in 1892 and for over thirty years have been reducing costs and simplifying output in many fields of industry.

We cast in aluminum tin, lead and zinc base alloys. Quotations furnished on receipt of samples or blueprints.

Write for booklets,
"Franklin Die-Castings in Modern Inventions"
and "Die-Casting."

FRANKLIN DIE-CASTING CORPORATION
Gifford and Magnolia Streets
Syracuse, N. Y.



Since 1919

SUPERCAST
QUALITY
DIE CASTINGS

Dependable SUPER CAST Die Castings

THE SUPERIOR DIE CASTING CO.
CLEVELAND

DIE CASTINGS

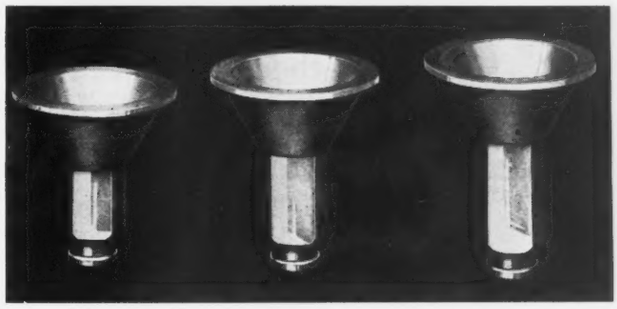
Prompt delivery guaranteed. Send samples, blueprints or sketches for estimates.

MT. VERNON DIE CASTING CORPORATION
MOUNT VERNON, N. Y.

ELECTRIC STEEL CASTINGS

Farrell-Cheek Steel Foundry Co.
SANDUSKY, OHIO

ALUMINUM CREAM SEPARATOR DISTRIBUTORS MADE BY THE PERMANENT MOULD PROCESS



(The distributor of a cream separator revolves at a very high rate of speed. It must be strong to withstand this speed and perfectly balanced. Also, it must be free from porous spots where milk can collect and sour.

Permanent Mould Aluminum Castings are *guaranteed* to be free from porous spots or blow-holes. They are stronger than either pressure aluminum die-castings or aluminum sand castings. This manufacturer of cream separators naturally chose to have his distributor parts made as Permanent Mould Aluminum Castings in preference to porous aluminum die-castings. Incidentally we were able to save him forty per cent of the weight of the distributor as formerly purchased in a sand casting and give him a casting as accurate as the best pressure aluminum die-casting he could buy.

You doubtless have parts that can be made more economically as Permanent Mould Aluminum Castings without sacrificing strength. Send sample or blueprint for quotation or write for further information and sample castings.

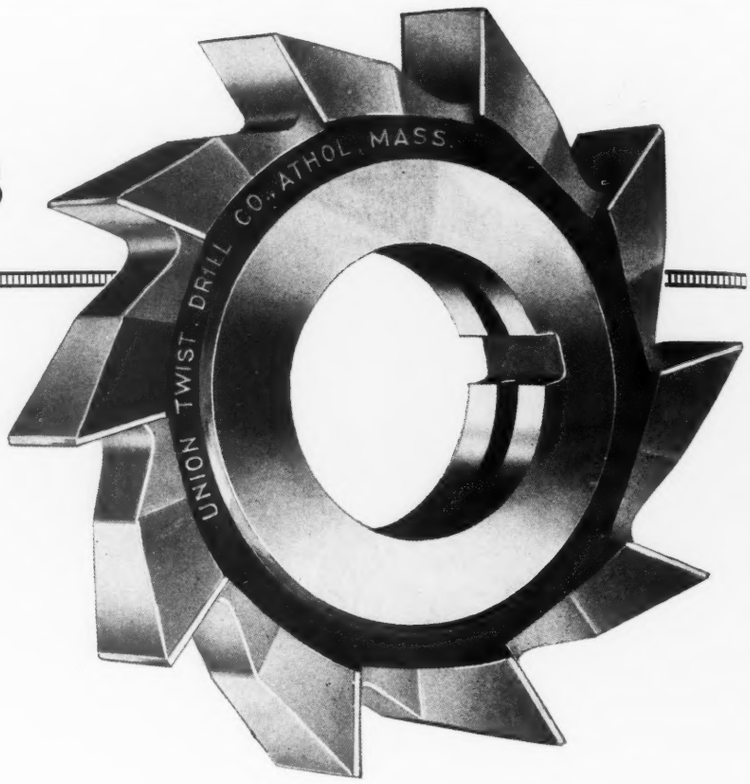
The Bronzo Alumina Corporation
Permanent Mould Aluminum Castings
BUFFALO, N. Y.

DETROIT
F. H. Bourke,
1577 Cadillac St.

PHILADELPHIA
J. T. Lloyd,
5452 Chestnut St.

NEW YORK
E. F. Whitaker,
15 Park Row

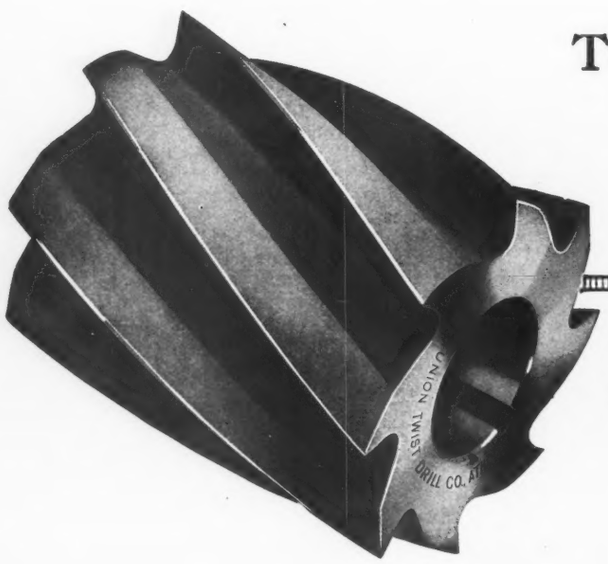
Union High Power Cutters



Tools that put Profits into Production

When we first developed Union High Power Cutters it was hard to convince manufacturers that our statements were not claims, but facts. Time and service, however, have proved that Union High Power Cutters cut faster, longer and require less power than ordinary cutters. Their wide-spaced, undercut teeth are stronger, have a shearing action without drag, and take less time to grind. The extra chip clearance prevents chips clogging and retarding the cutting action of the teeth and provides a better finish.

Users of Union High Power Cutters find that they permit increases in output, as high as 100% in some cases, with less heating of tools and work. A trial order will show you.



Twist Drills, Reamers,
Gear and Milling Cutters,
High Power Cutters, etc.

Union Twist Drill Co.

Athol, Massachusetts
U. S. A.



"Consider the Brass"

Quality in brass stampings is determined by the efficiency of the press, the expertness of the operator, and the **way the brass acts.** This depends on uniformity of temper, gage and width—and these, in turn, on the way the brass is made. The foundry, the metallurgical laboratory—all influence the result.

So—"Consider the Brass" —and its maker.

Long established, with a large and complete organization and well equipped plants producing uniformly high quality products in huge volume, we can guarantee that every step in the manufacture of Chase Brass is right. We can give you quality insurance that helps make press work profitable.

Are you on the list for the Chase Diamond?
All the news about brass, especially Chase Brass.

CHASE METAL WORKS

Division of Chase Companies Inc.

WATERBURY CONNECTICUT

PLANTS

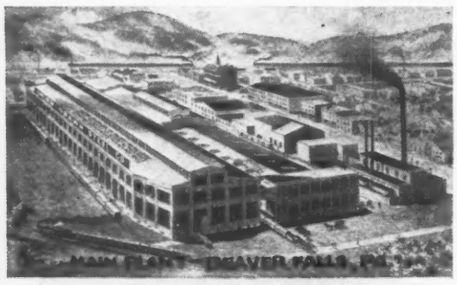
CHASE METAL WORKS — Trade CHASE Mark — CHASE ROLLING MILLS

New York Chicago Rochester Philadelphia Boston Pittsburgh St. Louis

The Chase Companies of California

San Francisco Los Angeles

The Ohio Chase Company, Cleveland





Union Drawn Service

Bright Finished Steel

We've been manufacturing cold-finished steel and iron in all standard and many special analyses required for industrial purpose, for the past thirty-four years.

Thousands of tons of finished and semi-finished steel are carried in stock in our three mills; thousands more in our five conveniently located warehouses.

In order to assure alloy steels with the exact physical properties specified by our customers we maintain also an extensive and up-to-date metallurgical laboratory and a modern heat-treating plant.

Our experience. our resources and our good will are yours to command.

WAREHOUSES
New York
Chicago
Detroit
Philadelphia
Cincinnati

Free Cutting Screw Stock, Cold Drawn Elevator Guides and Turned and Polished Shafting, Rounds, Flats, Squares, Hexagons, etc., in Bright Finish Bessemer, O. H., Nickel, Chrome and Vanadium Steel of unsurpassed quality. Catalog and quotations on request.

UNION DRAWN STEEL CO., Main Office Beaver Falls, Pa., Works Beaver Falls and Gary, Ind.

OTHER OFFICES AND WAREHOUSES—New York, 460-466 Washington St. Philadelphia, Ninth and Willow Sts. Cincinnati, 2225-47 Bogen St. Chicago, 570 West Adams St. Detroit, 237 Jos. Campau Ave. SALES OFFICES—Boston, Boston-Massachusetts Trust Bldg. Buffalo, White Building. Cleveland, Kirby Building. PACIFIC COAST REPRESENTATIVES—Milton Pray Co., Monadnock Bldg., San Francisco; Washington Bldg., Los Angeles, and L. C. Smith Bldg., Seattle, Washington.

Est. LUDLUM 1854

The Quest for Superiority In a Cutting Tool

The aborigine's quest for superior metals was often beset with peril—but he considered it worth while.

Today his crude ores and metals are made into myriad servants by the methods of modern man. One of the best results from such modern methods is

UTICA TOOL STEEL

—an ideal steel for threading tools, taps, gauges, punches, twist drills, reamers, form cutters, etc., or wherever a keen, durable cutting edge is desired. Free from tendency to warp or twist, crack or check when quenched in oil.

May we talk over your steel requirements with you?

See our many other wonderful steels

LUDLUM SPECIAL STEELS LUDLUM STEEL COMPANY — STEELS SPECIAL PURPOSES WATERVLIET-N.Y.-U.S.A.

STEEL BEARING BALLS

BRASS AND BRONZE BALLS



STEEL BURNISHING BALLS

ASK FOR PRICE LIST 104

THE ABBOTT BALL CO.
ELMWOOD HARTFORD, CONN.

C H E C K S

TIME—TOOL—PAY—IDENTIFICATION



No matter what size, style or shape check you require, sunk or raised letters, you'll find *PANNIER* a thoroughly dependable source of supply. Good facilities for quick deliveries and the assurance of dependable workmanship.

Been making them for MASTER PANNIER MARKERS *a quarter of a century.*

PANNIER BROS. STAMP CO., Pittsburgh, Pa.



Red Cut Cobalt
HIGH SPEED STEEL

Increased Their Output Almost Double

A specialty metal products manufacturing company of Ohio, have been using **RED CUT COBALT BITS** for facing, turning and boring forged steel gear bands for over two years and the results show typical Red Cut Cobalt performance.

The operation consists of removing 445 inches off diameter—the width of cut being 1″—the speed 118 feet per minute.

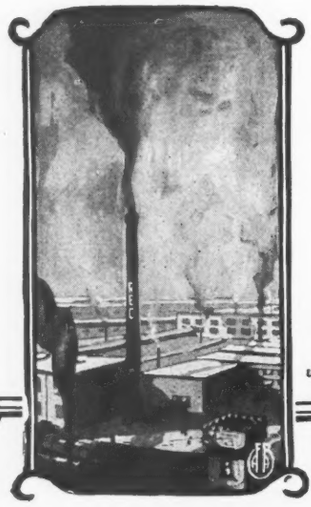
With **RED CUT COBALT BITS** between 18 and 21 pieces per hour are obtained—the highest number with other steels ranging from 10 to 12 pieces per hour.

There is probably an operation in your plant, too, where similar results can be obtained with **RED CUT COBALT.** Our Representative will be glad to demonstrate its efficiency and economy any time, on any operation you may select.

VANADIUM-ALLOYS STEEL COMPANY
LATROBE, PENNA.

WAREHOUSES:
Latrobe Chicago Detroit Springfield, Mass.

BRANCH OFFICES:
New York Boston Philadelphia Buffalo Pittsburgh
Cleveland Cincinnati Dayton St. Louis



The Reo Motor Car Co.
Lansing, Michigan
uses **HOYT** *Babbitt and Solder*

HOYT BABBITT

Where It's Different

AS far as outward appearance is concerned, there may be no difference between HOYT Babbitt and that of some unknown manufacturer. But when subjected to the acid test of active service, the inherent high quality of the HOYT product quickly differentiates it. The use of HOYT Babbitt for anti-friction service is your best protection against the too-frequent necessity of rebabbitting—against costly interruption of production.

Protect your investment by demanding only HOYT Babbitt.

GENUINE "A"

Wherever a Genuine Babbitt is desirable

EAGLE "A"

At a price lower than you'll expect

If your jobber can't supply you, we'll tell you who will—write us.

HOYT METAL COMPANY
ST. LOUIS - CHICAGO - DETROIT - NEW YORK
ALSO MANUFACTURERS OF
SOLDER - SHEET LEAD
BEARINGS *AND*
DIE CASTINGS



CAN YOU IMAGINE A MAN



who would choose an automobile by the price per pound, not realizing that performance is the real test of value? Bearing metal is exactly the same. It isn't what the metal costs, it's how long it performs, that really counts. Cheap metal that breaks down quickly is mighty expensive in the end.

Ajax Bull
Bearing Alloy

combines low cost and endurance in a surprising fashion. Try it out at our risk.

The Ajax Metal Company

Main Office and Works: PHILADELPHIA, PA.
New York Boston Chicago Cleveland
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MOLTRUP

Finished Machine Keys

Made and stocked in all standard types and sizes. Cold drawn steel is specially selected and prepared for the purpose. Accurate, full size, finely finished and long wearing. We also make them in sizes to meet special requirements. Send for prices.

Also: Ground and Polished Steel for general machinery construction, Cold Drawn Steel Shafting, Free Cutting Screw Steel, Rounds, Hexagons, Squares, Flats, Special Shapes and Finished Machine Racks.



Moltrup Steel Products Co.

BEAVER FALLS PENNSYLVANIA

DISTRICT OFFICES: New York, Woolworth Bldg.; Boston, 201 Devonshire St., Buffalo, 303 White Bldg., SALES AGENCIES: Central Steel & Wire Co., Chicago and Detroit; H. D. Cushman Company, Cleveland; R. E. Murray & Co., 308 McKevitt Bldg., Norfolk, Va.; Union Iron & Steel Co., Cincinnati.

Blue Chip

High Speed

and other

FIRTH-STERLING TOOL STEELS

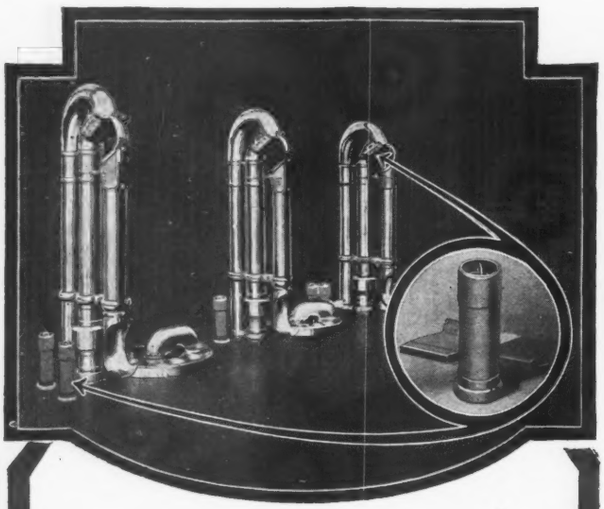
THE knowledge, experience and skill of SHEFFIELD combined with the best PITTSBURGH practice have made these steels the standards of QUALITY and UNIFORMITY wherever Tools are used

UNIFORM PRICES
UNIFORM TERMS
UNIFORM DELIVERY
TO ALL USERS

FIRTH-STERLING STEEL COMPANY

McKeesport, Pa.

NEW YORK BOSTON HARTFORD
PHILADELPHIA CHICAGO CLEVELAND
DETROIT LOS ANGELES



Spaulding Hard Fibre for great strength with light weight

When great strength, long life and light weight are important in the production of a machine part—then Spaulding Hard Fibre frequently becomes the most practical material with which to meet those requirements.

In the carrier system illustrated above, for example, both the doors at the ends of the tubes and the carriers themselves are made of Spaulding Hard Fibre—containing maximum strength and durability with minimum weight and cost.

PHYSICAL PROPERTIES:

Electro Rupture,
200 to 400 volts per 1/1000" thickness.

Tensile Strength,
10,000 to 20,000 lbs. per sq. in.

Compressing Point,
28,000 to 40,000 lbs. per sq. in.

Shearing Strength,
9,000 to 13,000 lbs. per sq. in.

If you are experimenting with the use of hard fibre, we will gladly give you the benefit of our experience if you will write us.

Furnished in sheets, rods, tubes and special shapes.

SPAULDING FIBRE COMPANY, Inc.
318 Wheeler Street, Tonawanda, N. Y.

BRANCH OFFICES AND WAREHOUSES:
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659-661 W. Lake St., Chicago
15 Elkins St., Boston, 27, Mass.
141 N. 4th St., Philadelphia
Clapp & Lamoree
171 Second St., San Francisco, Cal.
310 East 4th St., Los Angeles, Cal.

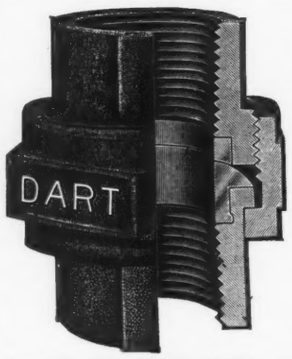
Spaulding HARD FIBRE

IN designing machinery operated or controlled by a spring, it frequently happens that the accommodation of a suitable spring is left to chance. Oftentimes expensive alterations must be made in the original model, and in some cases the entire machine rebuilt through the neglect of what usually appears to be a small item.

Before a casting is made or a part machined, submit your blueprints of new machinery to a spring manufacturer and make sure that he can supply you with an article that will fill your needs. If it happens to be a particular job, specify

CHATILLON PRECISION SPRINGS

JOHN CHATILLON & SONS
Established 1835
85-99 Cliff Street New York City, N. Y.



Dart Unions

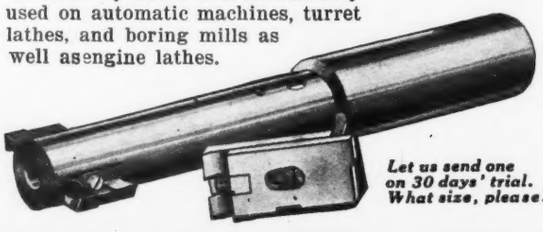
Last Longer than the Pipe!

They have bronze to bronze seats that can't rust or corrode; well cut threads that prevent leakage! They won't rust out, can't wear out. Unions, Ells, Tees, Flanges—send for a sample and price list.

E. M. DART MFG. CO., Providence, R. I.
The Fairbanks Co., Sales Agents.
Canadian Factory: Dart Union Co., Ltd., Toronto.

Buy Them "On Approval"

Madison Adjustable Boring Cutters and Bars cut accurate holes of any size; save reaming and grinding; can be set within .00025" in a few seconds time by an ordinary mechanic. successfully used on automatic machines, turret lathes, and boring mills as well as engine lathes.



Let us send one on 30 days' trial. What size, please?

MADISON MANUFACTURING COMPANY
MUSKEGON MICHIGAN

Ettco Self-Gripping Mandrels

Hold Securely Without Distorting the Work

A solid body of alloy steel with three grooves each containing a hardened roller and a long, flat spring. Slip the work into place and, when a cut is started, the rollers automatically grip it. When the job is done slide the piece off *by hand*. That's all there is to it—no hammering, no pressing.

Ettco mandrels do not expand but they *do grip*. Dirt does not bother them nor oil nor grease. They are heat-treated and ground .0002″ to .0004″ under size.

You try 'em—that's all we ask.

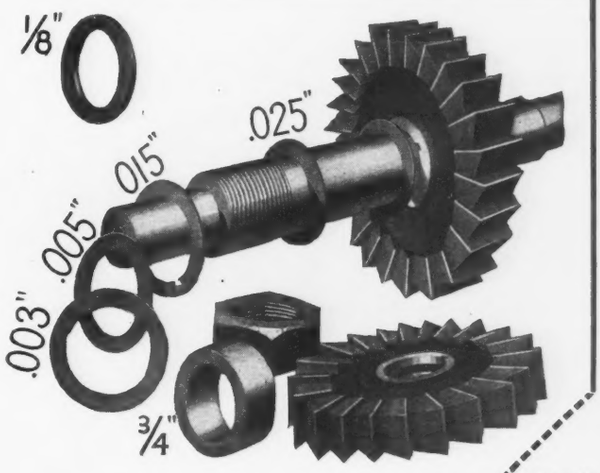


EASTERN TUBE & TOOL COMPANY, Incorporated

594 Johnson Ave. **BROOKLYN, N. Y.**

SPACERS

Up-to-date successors of the old-fashioned washer—made of good grade open hearth steel—produced by the thousand—marked for identification—sold for a fraction of the cost of home-made product. You can try some of them free, if you'll tell us the sizes you want. Fill in and mail the coupon.



M-8-23

Stock sizes with or without standard keyways—for arbors of the following diameters:

3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/4, 2 1/2, 3, 3 1/2 and 4 inches.

Stock Thicknesses: .003, .004, .005, .010, .015, .020 and .025 inch.

To Order: .0015 to 3.000 inches.

Detroit Stamping Company

3445-3459 West Fort St., DETROIT, MICH., U. S. A.

This Coupon is Provided for Your Convenience

Detroit Stamping Co.

3445-3459 West Fort St. DETROIT, MICH.

Gentlemen: Please send me price list of your Spacing Washers and free samples from the following sizes.....

Name.....

Position.....

Company.....

Address.....

GRANT GEARS

Made in any quantity, from single experimental gears or rush breakdown repair, to production orders; in all sizes from ¼" to 72".

Ask for latest catalogue

GRANT GEAR WORKS

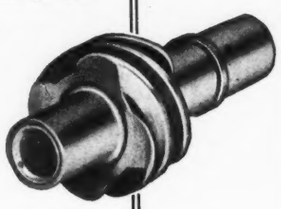
151 PEARL STREET, BOSTON, MASS.

MP
Reg.

Order By Name

Insist on quality—order by name—everything you buy. In no other way can you be sure of results.

Meisel Gears are specified over and over again by old customers who do not ask the price. They know that just as quality is right, prices are reasonable.

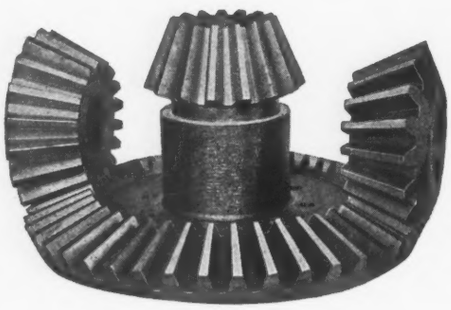


Also to your specifications screw machine work up to 5½"; Heat Treating, Broaching, Contract Work, Case Hardening, Tooth Rounding, Splining, External and Internal Grinding. Let us quote on your work.

MEISEL PRESS MFG. CO.
948 Dorchester Avenue
BOSTON, 25 MASS.

MEMBER OF AGMA

Cincinnati Gears

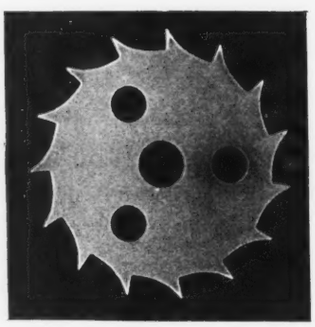


Our Customers Say—

Cincinnati Gears are accurate, long wearing and moderately priced. Their reports enable us to guarantee *your* satisfaction in these important parts.

Let us estimate on your needs.

THE CINCINNATI GEAR CO.
1825-1841 Reading Road
CINCINNATI OHIO



GENERATED

in our

Gear Cutting Department

(Cut is full size)

Let Us Quote You

MEISSELBACH-CATUCCI MFG. COMPANY
54 STANTON STREET NEWARK, N. J.

Adams-Farwell GEAR HOBBERS

Write for Catalog No. 809

THE ADAMS COMPANY 1910 Market Street Dubuque, Iowa, U. S. A.



BEVEL GEAR GENERATORS
BEVEL GEARS

CUT THEORETICALLY CORRECT

MEMBER OF AGMA

Special facilities for cutting Worm, Helical, Miter, Internal and Elliptical Gear Wheels.

The Bilgram Machine Works
1231 Spring Garden Street, Philadelphia, Pa.

Unusual Requirements Hold No Terrors for Phillie Gear

MEMBER OF AGMA

Specifications for the large bevel rawhide gear shown below gave Phillie Gear no more concern than the ones for the split bevel gear beside it. To be sure, rawhide gears of this size are a little out of the ordinary; but it would be difficult to specify any unusual gear requirement which Phillie Gear has not had to meet at one time or another during the years he has been specializing on gears.

Manufacturers from all parts of the country depend on him. Sometimes the order is merely a broken gear with a tag bearing his name on one side and the sender's on the other; sometimes it's a crudely drafted sketch giving dimensions and a hastily scrawled appeal to "Rush it."

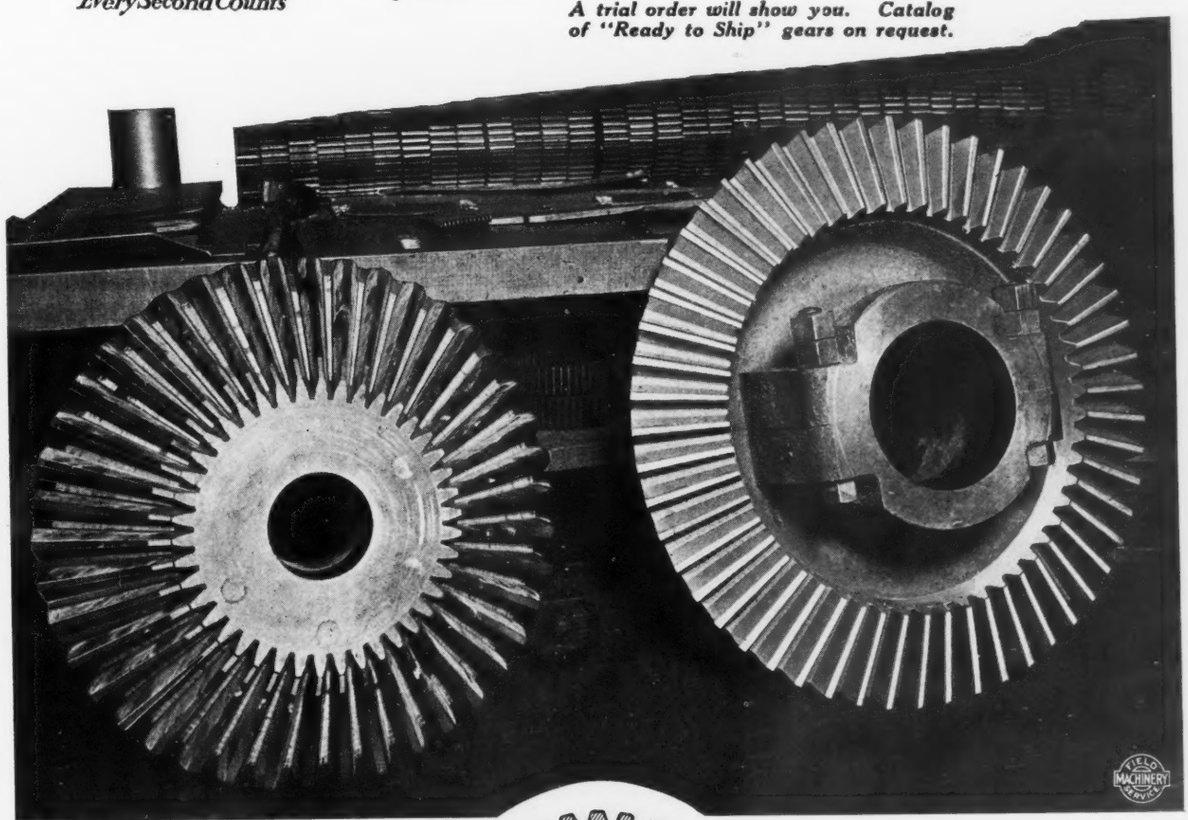
Phillie Gear never lets accuracy be sacrificed to speed. He has the equipment, the men and "know how" to produce gears of all styles and sizes, for every purpose.

PHILADELPHIA GEAR *TIME*



"Every Second Counts"

A trial order will show you. Catalog of "Ready to Ship" gears on request.

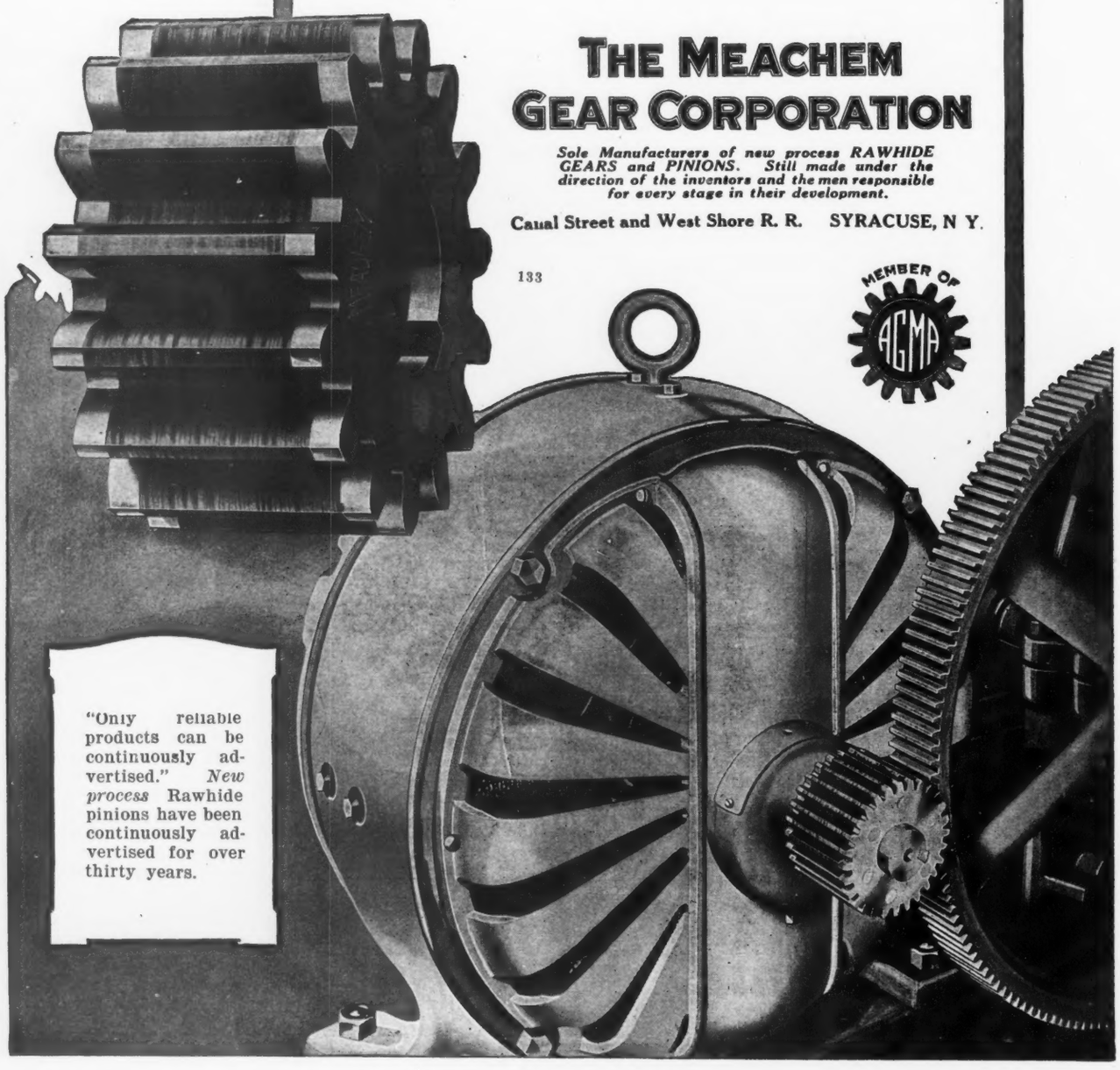


Philadelphia GEAR Works 1120-1128 Vine St Philadelphia

NEW PROCESS RAWHIDE PINIONS

eliminate the clatter and roar of metal-to-metal gear drives, thereby helping the men to think better and work better. Besides being quiet, their resilience absorbs the variations in load that set up destructive vibrations in the machine and impart a jerky motion to the tool. And *new process* Rawhide Pinions are strong and durable as well, frequently outlasting the metal gears which they replace.

It will pay you to try out a few *new process* Rawhide Pinions on your troublesome gear drives. The improvement which you will immediately notice will be permanent, for they are quiet and efficient even when worn.



THE MEACHEM GEAR CORPORATION

Sole Manufacturers of new process RAWHIDE GEARS and PINIONS. Still made under the direction of the inventors and the men responsible for every stage in their development.

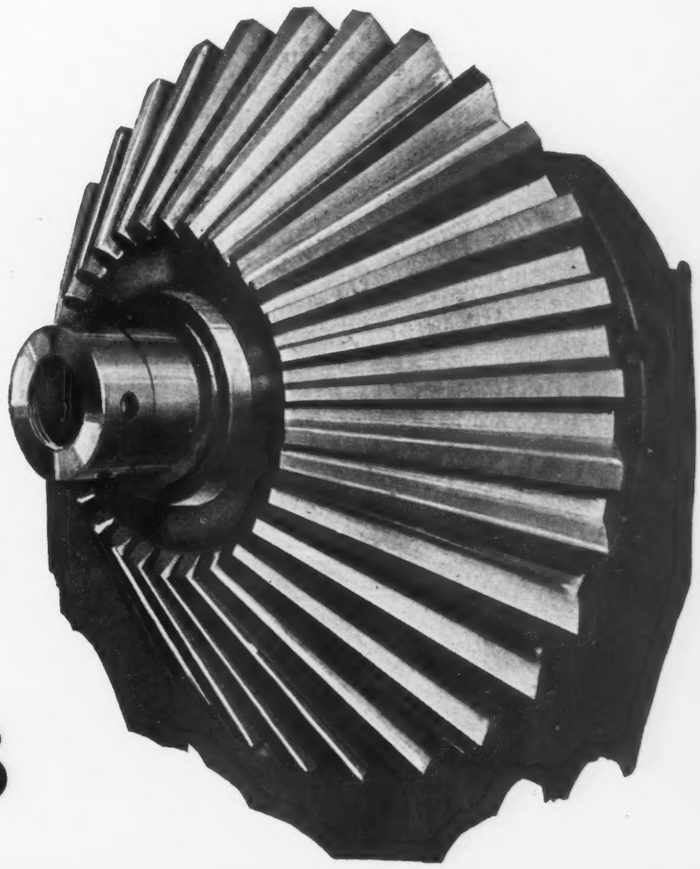
Canal Street and West Shore R. R. SYRACUSE, N Y.

133

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"Only reliable products can be continuously advertised." *New process* Rawhide pinions have been continuously advertised for over thirty years.

MEMBER OF AGMA



Foote Gears

Quality Gears and Prompt Delivery

FOOTE DEPENDABLE GEARS are highest quality gears. The metal used in them is carefully selected. The gears are accurately cut, closely inspected, and given rigid tests. This is why hundreds of the biggest and best known manufacturers use Foote Gears exclusively.

The Foote Organization can supply your gear requirements with speed and accuracy.

Submit your problems and let Foote quote prices on your requirements.

FOOTE BROS. GEAR & MACHINE COMPANY

Manufacturers of Rawhide and Bakelite-Micarta Pinions and Cut Gears of all Kinds. Special Machinery Made to Order. Submit your Blueprints

232-242 N. Curtis St. **CHICAGO, ILL.**



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Baltimore, Maryland
Murrill & Keizer

Boston, Massachusetts
Union Gear & Machine Co.
Blount Engineering Co.
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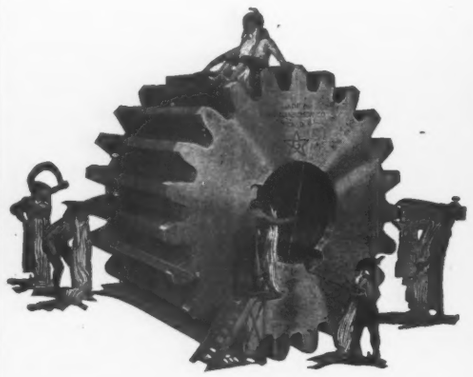
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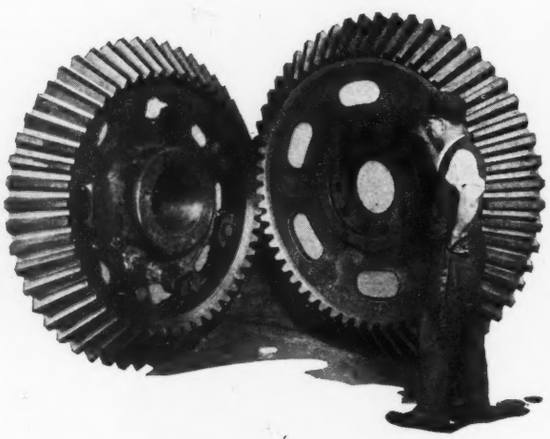
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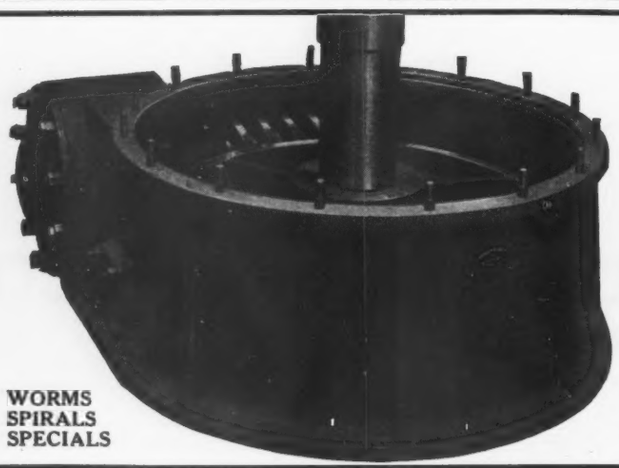
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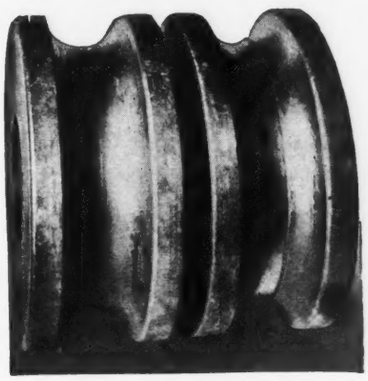
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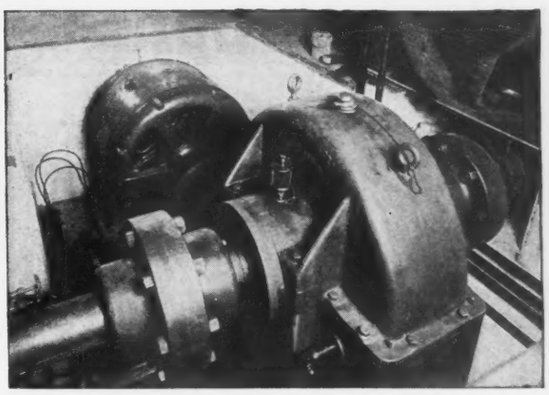
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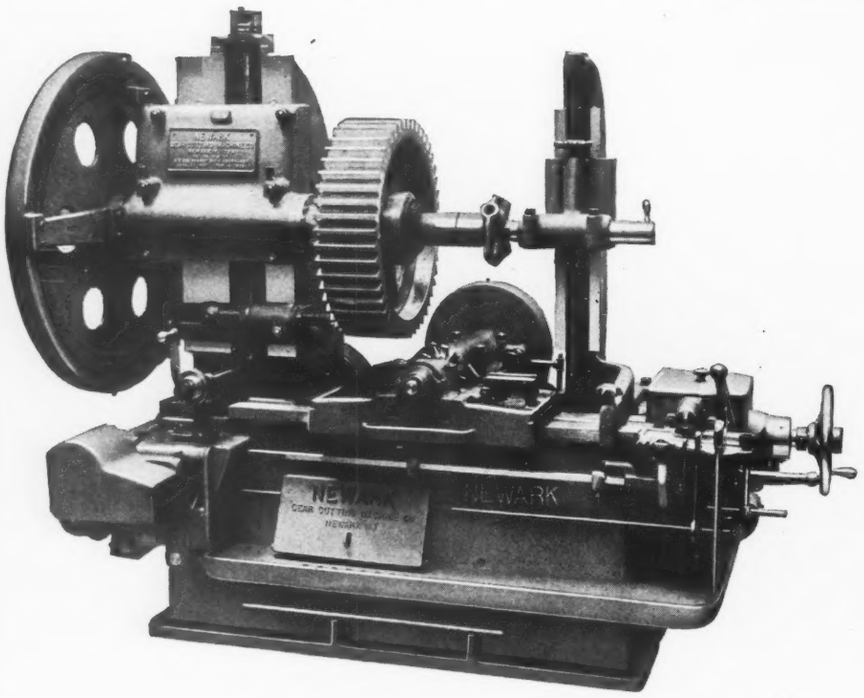
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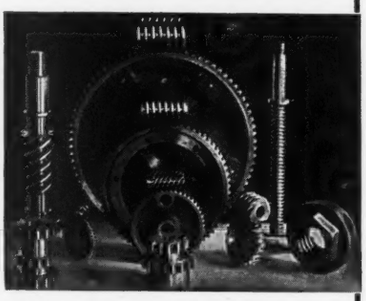
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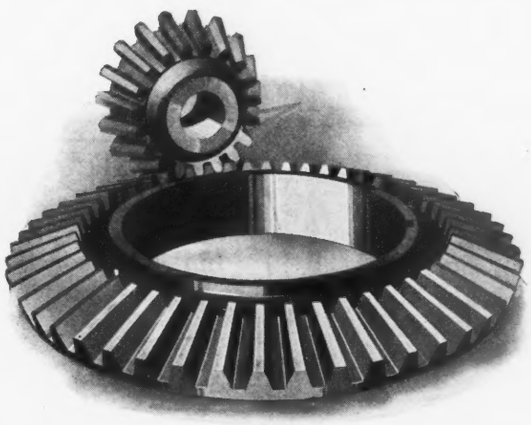
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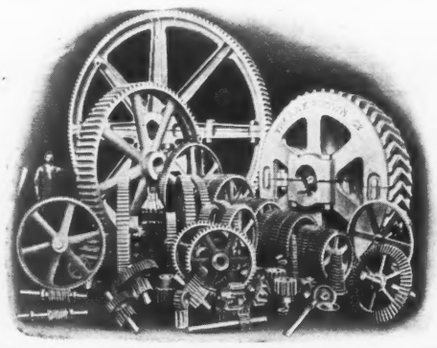
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5

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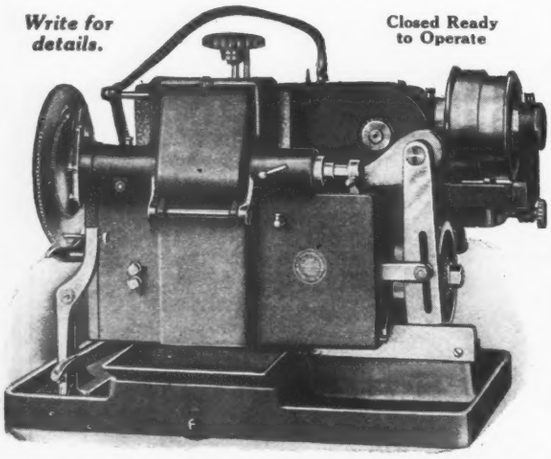
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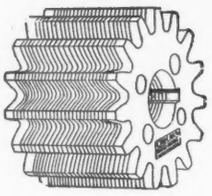
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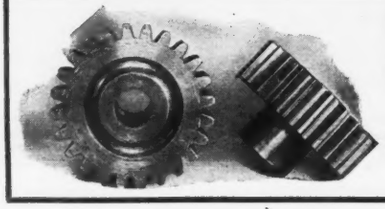
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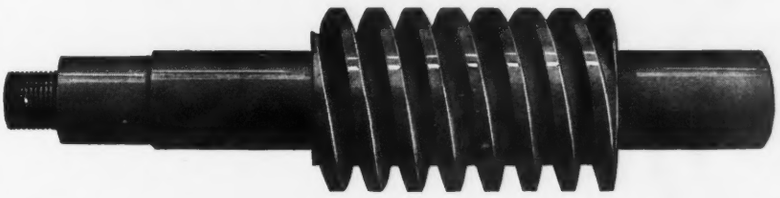
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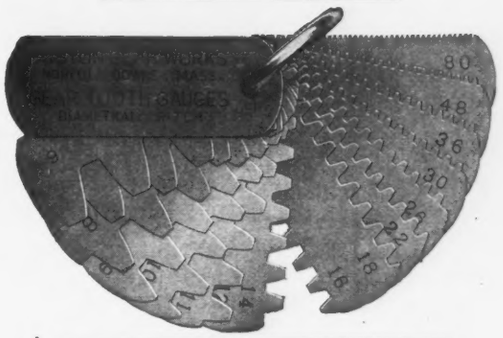
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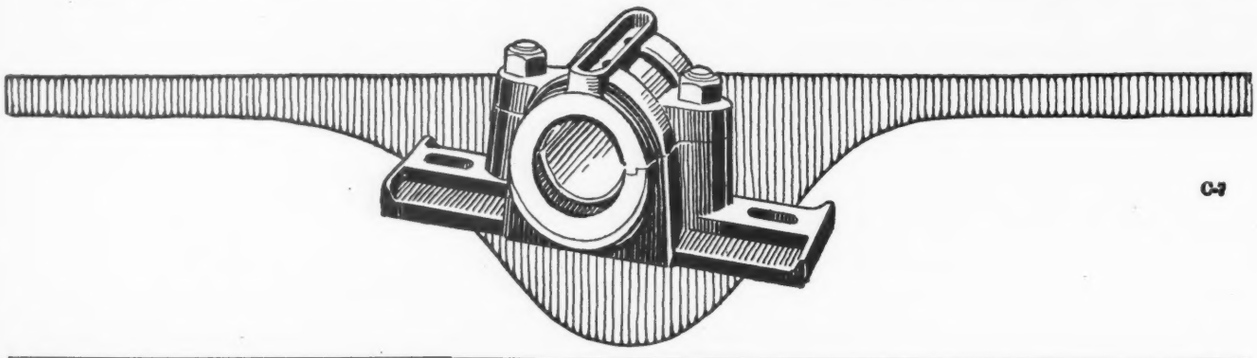
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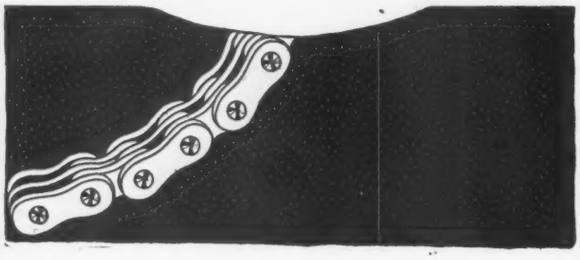
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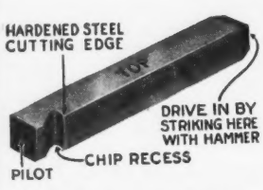
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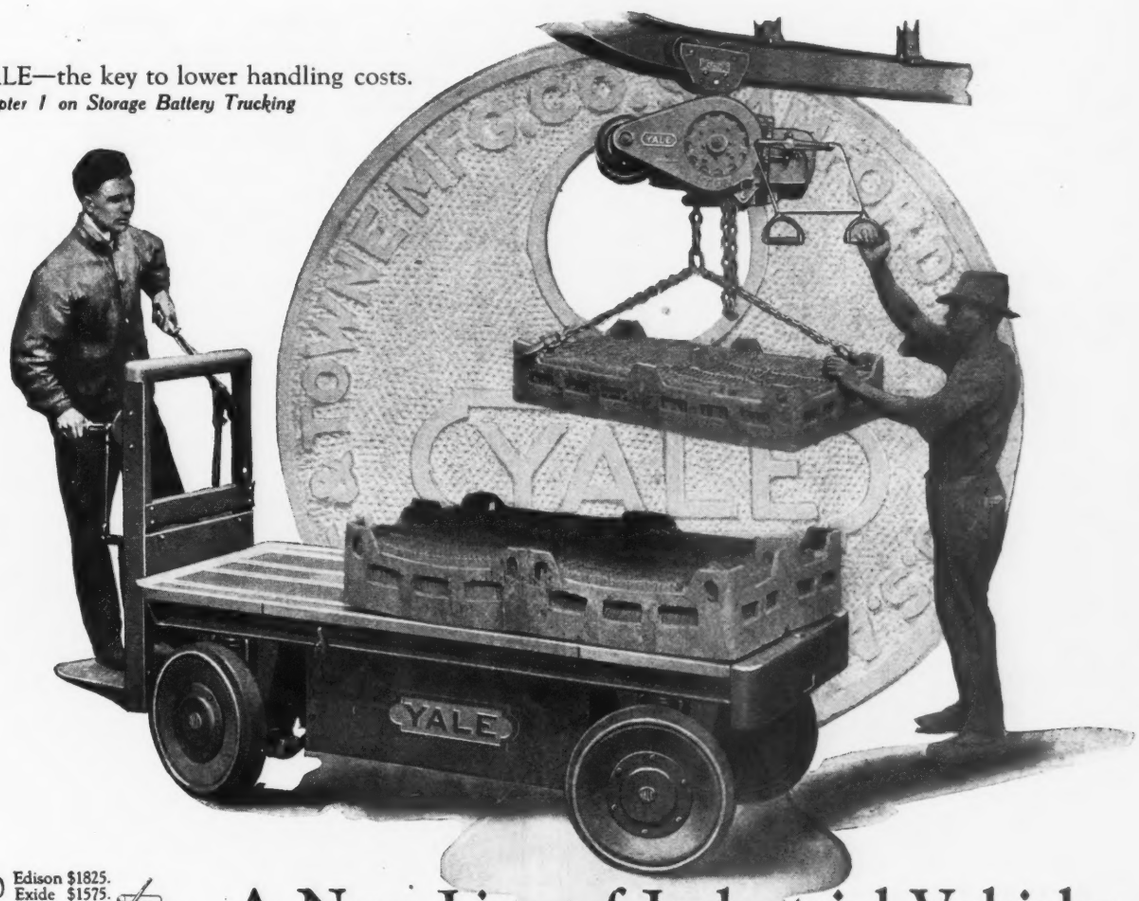


KEYTITE SELF-FITTING KEYS

Each key has a hardened steel cutting edge on the side and on the top, too, if desired. Drive in with a hammer and leave there—that's all. The cost for the installed key is less and the job is more secure.

SMITH & SERRELL, 46 Central Avenue, Newark, N. J.

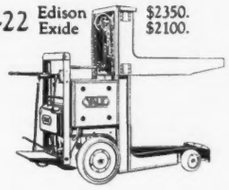
YALE—the key to lower handling costs.
Chapter I on Storage Battery Trucking



K-20 Edison $1825. Exide $1575.



K-22 Edison $2350. Exide $2100.



K-23 Edison $1825. Exide $1575.



K-24 Edison $1925. Exide $1675.



All prices F. O. B. Works

A New Line of Industrial Vehicles

BUILT to standardized specifications with a majority of parts interchangeable between models, with every Yale ideal of quality and service maintained to the utmost degree, this new line of industrial vehicles represents a very striking achievement.

Since 1875 the Yale line of material handling equipment has been steadily increased in scope and effectiveness, until it now includes Hand Chain Blocks, Electric Hoists, Overhead Haulage and Industrial Trucking Systems.

In 1901 the first of the series ot models was built from which this entirely new line of Yale Industrial Trucks and Tractors has been developed, unique in many ways, efficient beyond all previous experience —and at prices made possible by automotive production methods.

Today, Yale engineers are ready to analyze your operating conditions and to demonstrate in your plant the advantages and economies ot electric truck transportation.

The Yale & Towne Manufacturing Co.
Makers of Yale Products—Locks, Door Closers and Material Handling Equipment
Stamford, Conn., U. S. A.
Yale Made is Yale Marked

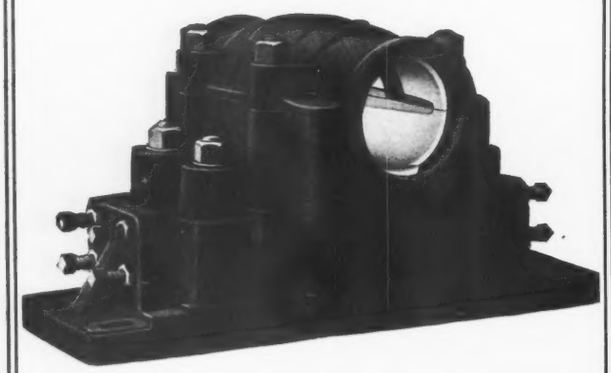
MATERIAL HANDLING EQUIPMENT

for Vertical Travel
Yale Chain Blocks
Yale Electric Hoists

TRADE YALE MARK

for Horizontal Transfer
Yale Trucks & Tractors
Yale I-Beam Trolleys

Lining up your Main Shaft



and keeping it in line is made comparatively easy with this combination.

It is an Extra Heavy, Rigid Pillow Block, Mounted on a Wedge Adjusting Base Plate. Adjustable both vertically and longitudinally.

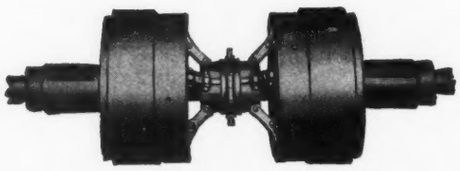
The Bearing may be either Ring Oiling, Wick Oiling or Chain Oiling, whichever you prefer. The Babbitt lining is finished accurately to shaft size and ends of bearing are faced for collars.

This is only one of the twelve different styles of Pillow Blocks we manufacture. If you are interested in any kind of pillow block, we have it, as well as any other appliance for the Transmission of Power by Belts or Ropes.

T. B. WOOD'S SONS CO.

CHAMBERSBURG, PA.

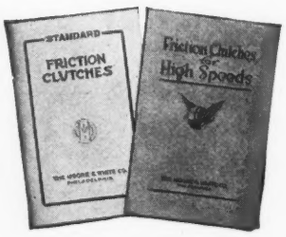
POWER TRANSMITTING MACHINERY



Why so many are in use

Moore & White Friction Clutches live up to specifications; minimize and prevent accidents; save power; require no attention; are practical and positive in operation.

Clutches for low speeds, high speeds and great horsepower.

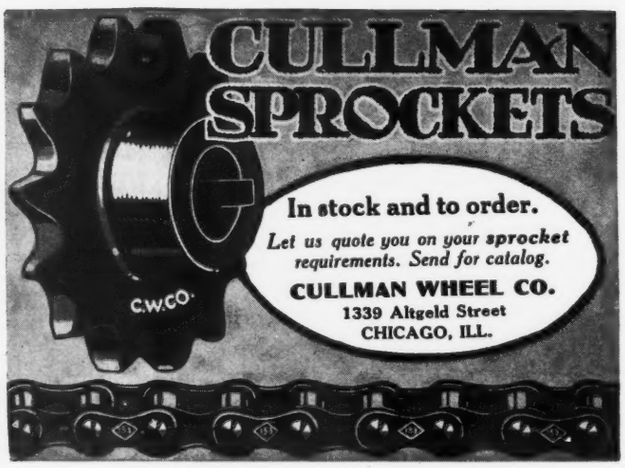


Let us help you to select the clutch to meet your special needs. Write for the books—they're full of information.

THE MOORE & WHITE CO.

Established 1886

2707-2737 North 15th St., Philadelphia, Pa.



"AETNA" THRUST BALL BEARINGS

STANDARD and SPECIAL DESIGN

Guaranteed to be noiseless. Specially designed for machinery of all descriptions. Put your bearing problem up to us.

AETNA BALL BEARING MFG. CO., 2737-2745 High St., Chicago, Ill.

ROLLER THRUST BEARINGS

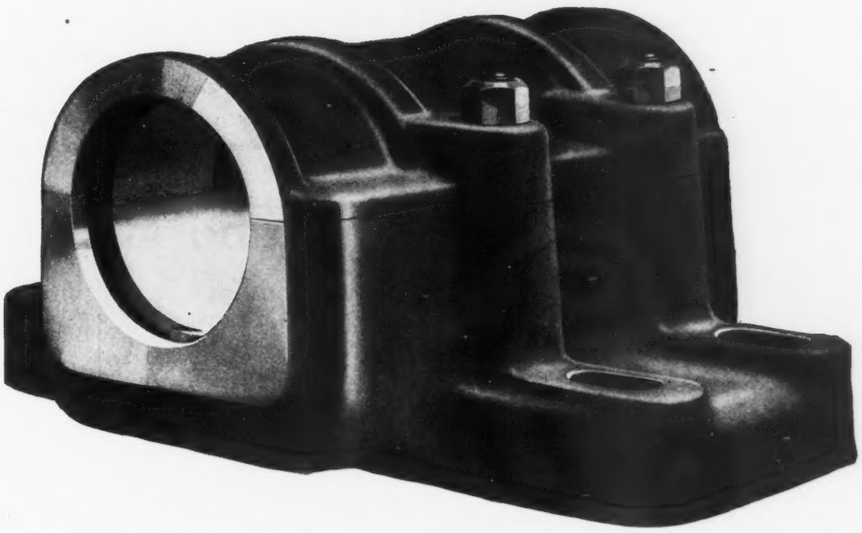


STANDARD DIMENSIONS or to ORDER.

One—or one thousand

The Gwilliam Company

253 W. 58th St. NEW YORK

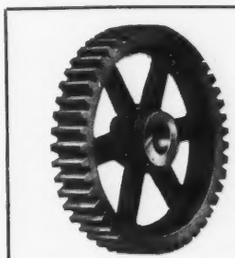


The JONES Rigid Pillow Block —Duplex Ring Oiling

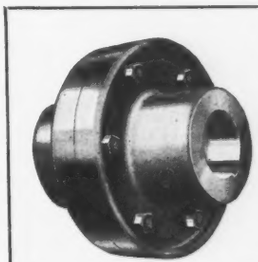
Exceptionally rugged and durable—large oil reservoir—has two rings and a wool felt wick to provide positive and ample lubrication at all times. Bearings are babbitted, actually "lathe bored," and are finished at both ends for smooth collar contact—bases are finished. Strictly a ***Quality*** product in every sense of the word.



Jones Cast-iron Pulley



Jones Spur Gear



Jones Flange Coupling

W. A. Jones Foundry & Machine Company

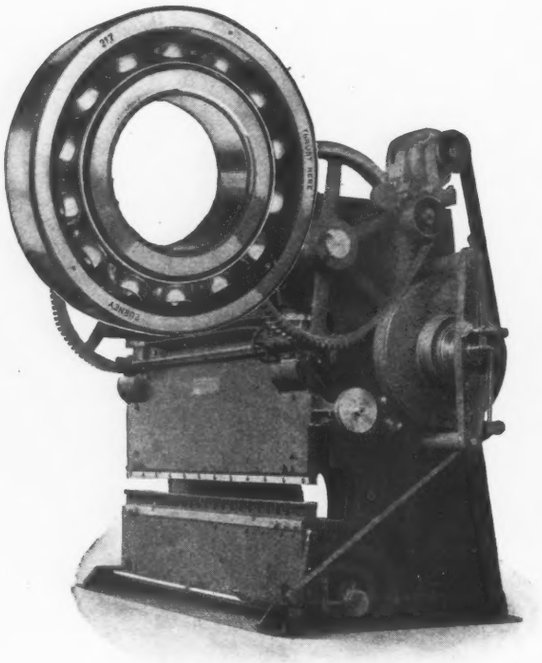
Main Office and Works: 4409 West Roosevelt Road, CHICAGO

Branches: New York—Pittsburgh—Buffalo—Milwaukee

Jones

Power Transmitting Machinery





Cincinnati Brake or Plate Forming Machine

This interesting machine, in order to withstand the tremendous stresses without deflection or distress, is built of steel throughout, instead of cast iron.

It is natural, in such a machine, that all important bearings such as the bearings of the big clutch pulley, the idler on worm shaft—some eight bearings in all—are Gurneys.

Gurney Engineers are experienced in solving difficult bearing problems—let them help you with yours.

Gurney Ball Bearing Co.
JAMESTOWN, N. Y.

GURNEY BALL BEARINGS

18209

THE "Commercial" ANNULAR BALL BEARING

The High Cost

of production can sometimes be materially reduced by the use of Schatz "Commercial" Annular Ball Bearings, correctly designed and adapted in material and workmanship to the service required.

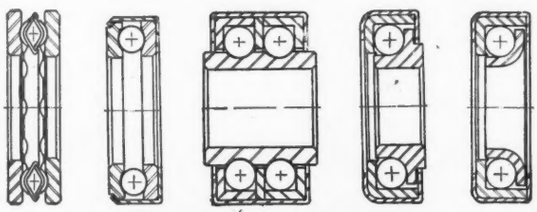
Inexpensive. For moderate radial and radial thrust loads at 3000 r.p.m. or less.

Catalog, discount sheet and samples



The Schatz Manufacturing Co.
Poughkeepsie, N. Y.

BALL NICE BEARINGS
TRADE MARK REG. U.S. PAT. OFF.



ECONOMICAL—EFFICIENT
BOSTON GEAR WORKS
NORFOLK DOWNS, QUINCY, MASS.
BOSTON NEW YORK CLEVELAND CHICAGO



NICHOLSON COMPRESSION SHAFT COUPLING

No keyways; cannot slip; jaws grip powerfully enough to twist off 5" shaft.

Reducing coupling for shafts of different diameters.

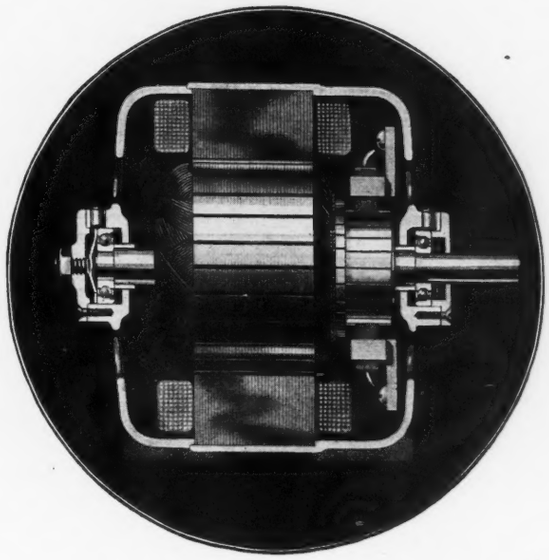
Sizes 1 3/16" to 6 15/16".

Always in stock—Quick Delivery. Write for prices.

The Old Reliable

W. H. NICHOLSON & CO., 112 Oregon St., WILKES-BARRE, PA.

A Good Motor on Machine Tools Maintains Production and Reduces Cost



When the motor stops, the machine stops—production ceases, overhead continues, unit costs rise. Look—then—to the quality of the motor you buy. Be sure it is dependable, economical of current and lubricant, ample in power, capable of standing occasional neglect. And remember—experience proves that most "motor troubles" are "motor bearing troubles," which are anticipated and guarded against in motors built as motors can be, and should be, built.

Fractional H. P. Motors Equipped with

"NORMA" PRECISION BALL BEARINGS

Have Higher Electrical Efficiency
Due to the smaller air gap and reduced magnetic leakage.

Have Higher Mechanical Efficiency
Because friction in the bearings is greatly reduced.

Use Less Current
Because of higher electrical and mechanical efficiency.

Start More Quickly
Because of the reduced bearing friction.

Are More Compact
A shorter shaft is possible—important, often.

Have Magazine Lubrication
Need oiling only at long intervals.

Are More Easily Maintained
Can be quickly opened up, inspected and cleaned.

Are Cleaner
No throwing of oil—the bearings are packed.

Last Longer
Because friction is minimized and lubrication assured.

Do More Work
Because capable of continuous service.

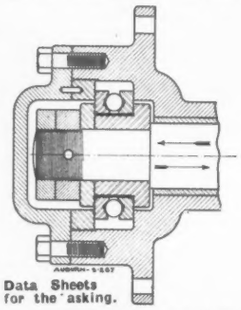
A booklet will be sent on request. And our engineers will welcome an opportunity to work with yours.

THE NORMA COMPANY OF AMERICA

Anable Avenue Long Island City New York

BALL, ROLLER AND THRUST BEARINGS

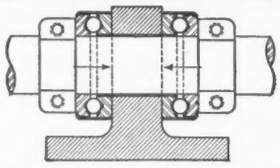
DOUBLE THRUST PROBLEMS answered by AUBURN BEARINGS



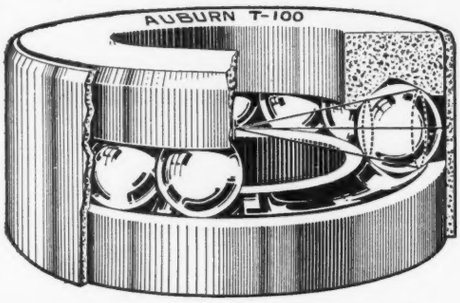
Data Sheets for the asking.

Auburn Ball Thrust Bearings answer many difficult problems by the different Styles or Designs in which they are made, each having definite advantages for certain operating conditions.

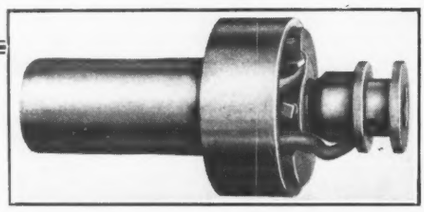
The illustrations show **AUBURN ANSWERS** to two difficult problems. Write us about your bearing difficulties.



Steel, Brass and Bronze Balls



AUBURN BALL BEARING CO. Trade Mark Established 1893 **33 Elizabeth St., Rochester, N. Y.**



ACHIEVEMENT has proved that the

CONWAY CLUTCH

can transmit a larger factor of power in a given space allotment.

Easy engagement. Instant release. Fool-proof adjustment. Interchangeable parts. Free idling. Capability for overload in the "pinch."

. . . . . You are missing something, if you try to start and stop excellent mechanisms without CONWAY CLUTCHES.

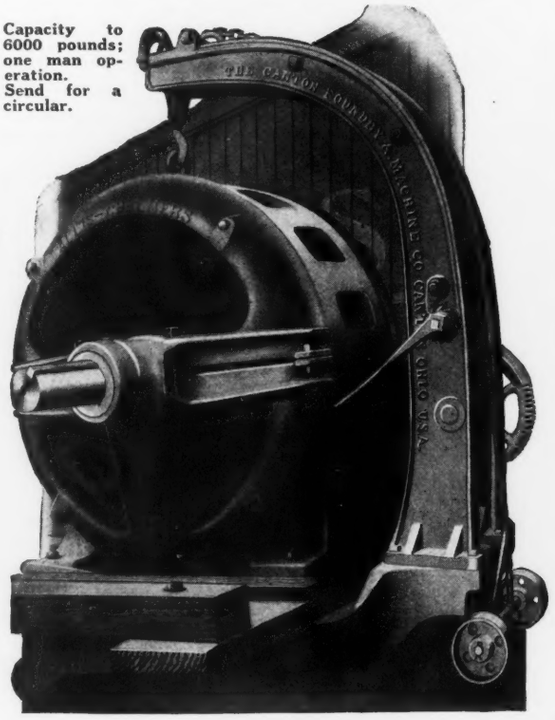
Incorporate dependability into your product.

THE CONWAY CLUTCH CO.
1962 W. Sixth St. CINCINNATI, OHIO

Use a Canton Crane

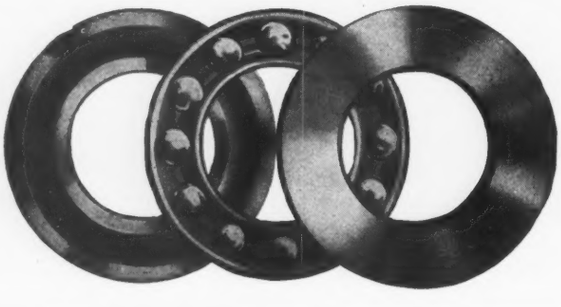
to simplify setting up parts like this.

Capacity to 6000 pounds; one man operation. Send for a circular.



CANTON FOUNDRY & MACHINE COMPANY
CANTON, OHIO
New York Office, 203 East 15th Street

THE BEARINGS COMPANY OF AMERICA



Your present Thrust Bearings sizes duplicated. Thrust Ball Bearings made to your B/P's. Quotations made promptly on all inquiries.

THE BEARINGS COMPANY OF AMERICA

Western Sales Office,
1012 Ford Bldg., Detroit, Mich.

LANCASTER, PA.

Arguto OILLESS BEARINGS
Need No Lubrication

A Quarter Century Without Oil



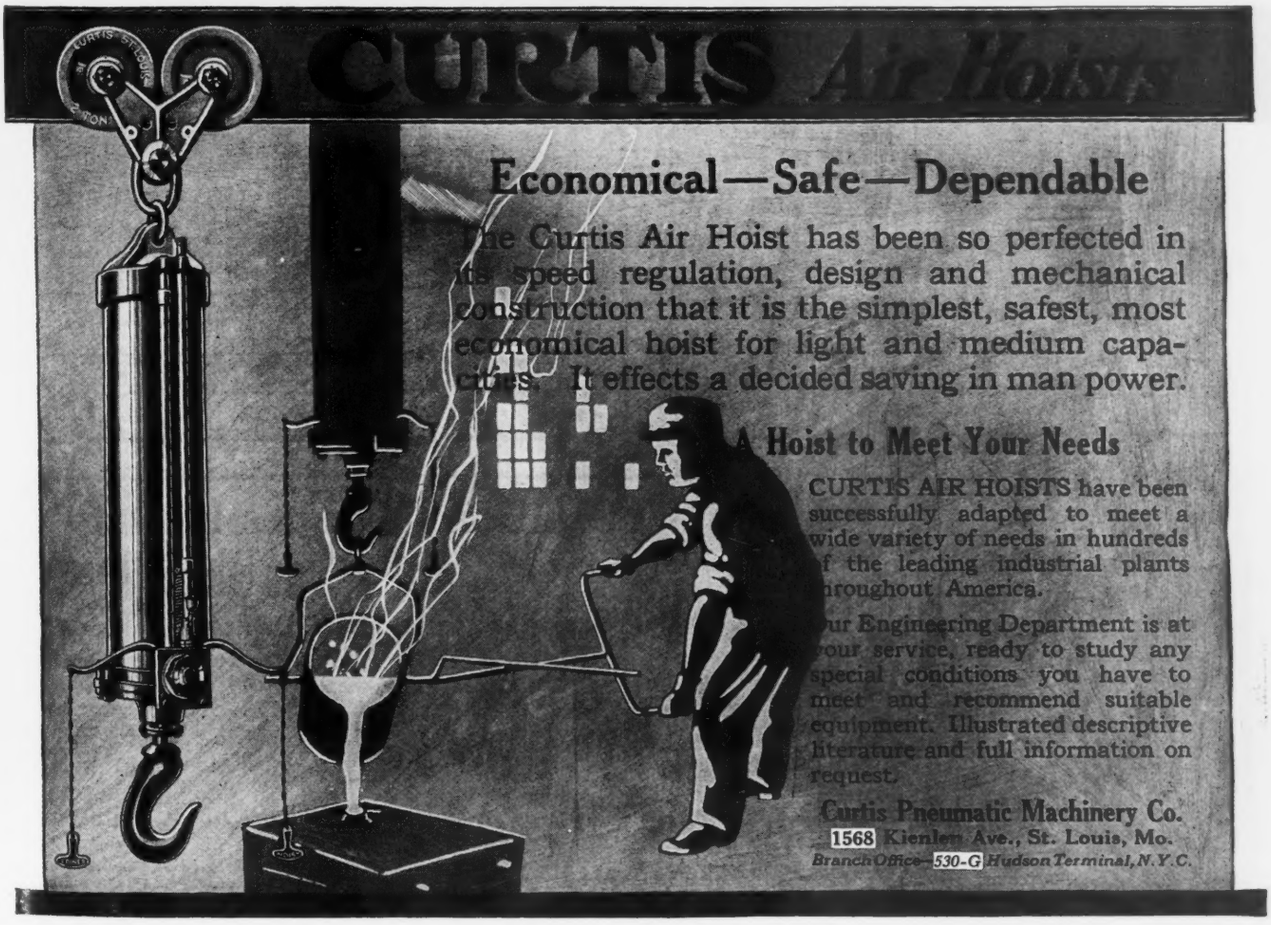
Think of installing a bearing and forgetting it for 24 years. Not a drop of oil nor any labor charges in a quarter century. This is the record of an Arguto Oilless Bearing. For some 30 years Arguto has been the solution of loose pulley, clutch and other inaccessible bearing troubles and thousands of concerns all over the world have availed themselves of it. For these concerns the oil can *is* abandoned.



We do not recommend Arguto for all bearings; but welcome the opportunity of going over your problems. Write us.

ARGUTO OILLESS BEARING CO.
Wayne Junction — Philadelphia

CURTIS Air Hoists



Economical—Safe—Dependable

The Curtis Air Hoist has been so perfected in its speed regulation, design and mechanical construction that it is the simplest, safest, most economical hoist for light and medium capacities. It effects a decided saving in man power.

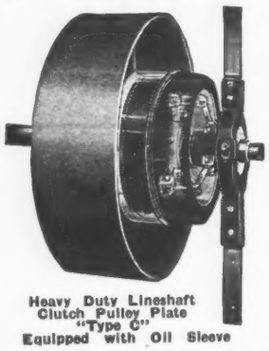
A Hoist to Meet Your Needs

CURTIS AIR HOISTS have been successfully adapted to meet a wide variety of needs in hundreds of the leading industrial plants throughout America.

Our Engineering Department is at your service, ready to study any special conditions you have to meet and recommend suitable equipment. Illustrated descriptive literature and full information on request.

Curtis Pneumatic Machinery Co.
1568 Kienlen Ave., St. Louis, Mo.
Branch Office—530-G Hudson Terminal, N.Y.C.

EDGEMONT CLUTCHES Wherever Power is Applied



Heavy Duty Lineshaft Clutch Pulley Plate "Type C" Equipped with Oil Sleeve

Edgemont Friction Clutches absorb all the shock, take all the abuse of rough service, can be thrown in and out constantly or slip and pick up the load very slowly without injury.

A special woven burn-proof asbestos composition is used as a liner, instead of fibre and wood block, which is easily destroyed by heat under friction.

Simple, fool-proof, positive, economical and above all *safe*. Let us tell you more about them.

Edgemont Clutches, Clutch Pulleys, Cut-off Couplings, Extended Sleeve Clutches and Special Clutches for all Purposes—described in Catalog "G".

THE EDGEMONT MACHINE COMPANY

2700 National Avenue . DAYTON, OHIO, U. S. A.



THE REASON

for the Greater Precision, Less Friction and Longer Life of the

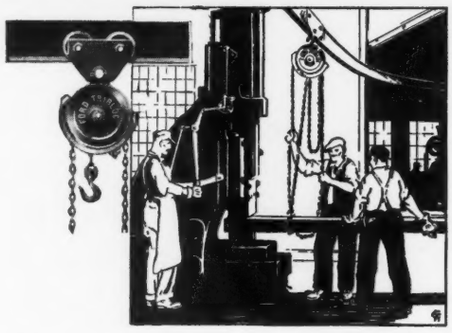
Schatz
"UNIVERSAL"
Registered *Annular* U.S.Pat.Off
BALL BEARING

is careful manufacturing and the three area contact which withstands thrust loads and provides a greater wearing surface.



THE FEDERAL BEARINGS CO., Inc.
POUGHKEEPSIE
N. Y.

FORD TRIBLOC



Hauling and Holding

THE Tribloc not only facilitates lifting and lowering—it also facilitates hauling and holding. Suspended from a roller-bearing trolley running on an I-Beam track, the Tribloc with its load can be quickly and easily hauled to any point. There, the load can be lowered or steadily and securely held as illustrated above.

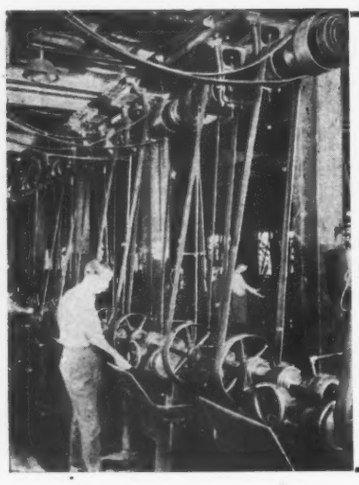
Write for Catalog 5-B for Triblocs in capacities up to 40 tons

2219-D

FORD CHAIN BLOCK CO.
END & DIAMOND STREETS PHILADELPHIA, PA.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U. S. A.

PARIS BRUSSELS TURIN BARCELONA RIO DE JANEIRO,



600 Hilliard Friction Clutches Increase Machine Efficiency in this Big Plant

This photograph taken in the Coaster Brake Hub Shaving Department of the New Departure Manufacturing Company, Bristol, Connecticut, shows a few of the Hilliard Friction Clutches in this plant.

Positive, easy, individual control for each machine gives increased efficiency; the elimination of elaborate overhead rigging reduces equipment and upkeep costs. Hilliard Friction Clutches are a profitable investment. Let us tell you more about them.

The Hilliard Clutch & Machinery Company

ELMIRA, N. Y., U. S. A.



Performance the Gauge of Bushing Quality

In a record non-stop run of 3155 miles, at an average speed of more than 60 miles per hour, this Stock Duesenberg "Straight-Eight," fed by a supply car, established an endurance record probably never equalled by a motor car.

As parts of this remarkable car, Johnson Bronze Standard Bushings performed 100%.

Johnson Bronze Standard Bushings are made in all types and sizes, to meet your every requirement.

The bushings you require will probably be found in our stock list, obtainable in small quantities at large quantity prices.

JOHNSON BRONZE COMPANY
NEW CASTLE, PA.

JOHNSON BUSHINGS

DIAMOND
Chains and Sprockets

DIAMOND Roller and Block Chains are made in sizes ranging from ⅜" to 2" pitch, and from ⅛" to 1¼" in width. This offers you correct chain models for the widely varying needs of machinery drives. Diamond Sprockets are made in types and sizes to suit various chain drive requirements. Write for DIAMOND Chain catalogs, or send your chain drive specifications for quotations. Ask for a copy of our Chain Data Book.

DIAMOND CHAIN & MFG. CO. Indianapolis, U.S.A.
Makers of High Grade TRADE MARK *Chains Since 1890*

SASH AND CABLE CHAINS



SASH CHAIN



No. 00 SASH CHAIN



No. 110 CABLE CHAIN

THE SMITH & EGGE MFG. CO.
BRIDGEPORT, CONN.
SASH CHAIN ORIGINATORS

Announcement

AN entirely new type of pressed steel shaft hanger combining unusual strength and rigidity with accurate alignment adjustments and a pleasing and graceful design.

This new American Pressed Steel Shaft Hanger is the result of a quarter of a century of experience in power transmission problems.

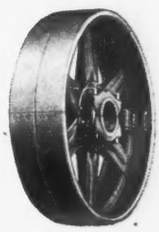
This shaft hanger is in every way a worthy companion to the American Pulley, for twenty-five years accepted as a standard of pulley excellence.

This hanger carries with it the guarantee of The American Pulley Company, the same guarantee which stands back of the American Pressed Steel Pulley.

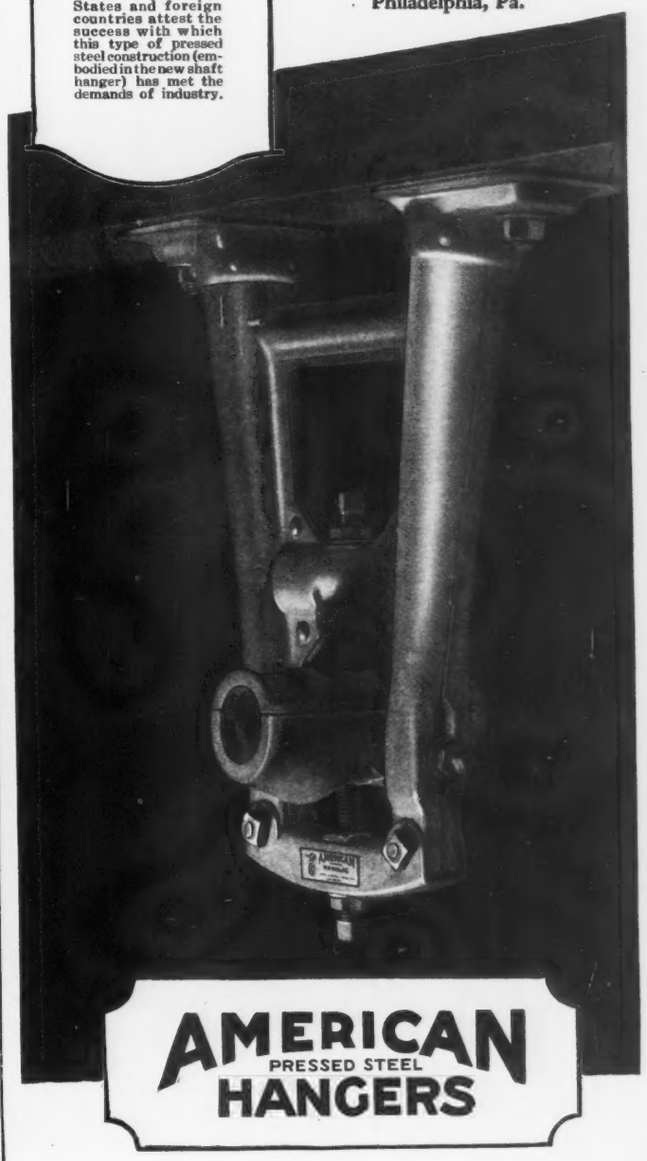
More complete description of these new American Pressed Steel Hangers is contained in a special folder. A request will bring you a copy promptly.

For complete list of distributers see MacRae's Blue Book.

The American Pulley Company
Manufacturers of Steel Split Transmission Pulleys, Steel Sash Pulleys, Pressed Steel Shaft Hangers, and Pressed Steel Shapes
Philadelphia, Pa.



NEARLY six million American Pulleys in service in the United States and foreign countries attest the success with which this type of pressed steel construction (embodied in the new shaft hanger) has met the demands of industry.



AMERICAN
PRESSED STEEL
HANGERS

Spin the Load around with your little finger

WRIGHT HOIST

Ball Bearing Swivel Hook makes this possible and Prevents this



Detachable Shackle

A quick attachment or detachment of link to shackle is made possible by this new Wright hook. Just a small wrench and a very few minutes' time is all that is necessary to install.

It fits every load chain link. Let us tell you more about it.

Send for our latest Catalog

WRIGHT

MANUFACTURING COMPANY
LISBON, OHIO.

IMPROVED HIGH SPEED HOIST

GREASE CUPS!



Empress Grease Cup No. 249



Empress Oil Cup No. 52

Empress Cups Insure Perfect Lubrication for Your Machines

They keep the dirt out—let the lubricant in; small but important accessories, they solve the lubrication problem for the machine designer. Specify Empress lubricators.

The large cut shows the Empress Grease Cup No. 249; the small one Empress Oil Cup No. 52—two of our most popular cups. Advise the one you want (both if you're interested) and we'll send samples.

REG. U. S. PAT. OFF. Empress

Mail the Coupon To-Day

BOWEN PRODUCTS CORP., Auburn, N. Y.

Clip this coupon and attach to your letterhead.
Please send me sample of your Empress Grease Cup No. 249. ☐ Empress Oil Cup No. 52 ☐ and Catalog No. 101 J of your entire line.

NAME ..... TITLE .....

FIRM .....

ADDRESS .....

M-8-23

Duckworth Specialty Chains



The above cut represents our No. 190 ½" Pitch Roller Chain, designed particularly for all kinds of Wrapping, Folding, Labeling and Cutting Machines. We have many other models, each especially fitted for some individual task. Our prices are low enough to be attractive and all our Chains are of flawless quality. We shall be glad to send our catalog and offer estimates.

DUCKWORTH CHAIN & MFG. CO.
Established 1871
40 Mill Street SPRINGFIELD, MASS.

ROEPER

ELECTRIC AND HAND POWER
TRAVELING CRANES
MONO-RAIL HOISTS
TROLLEYS
ROEPER CRANE & HOIST WORKS
READING, PA.



THE BANTAM BALL BEARING CO.
BANTAM, CONN., U.S.A.

Thrust Bearing Specialists

Bearings Made To Your Requirements

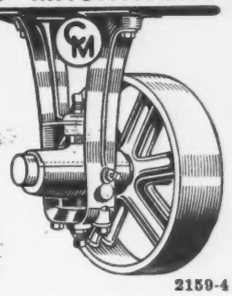
DETROIT OFFICE: 905 Dime Bank Bldg., Detroit, Mich.

PACIFIC COAST:
Frank M. Cobbledick Co. 1031 Polk St., San Francisco, Cal.
F. M. BOYD, The Avon, 6 East Read St., Baltimore, Md.

CRESSON-MORRIS

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General Power transmitting machinery; Shafting; Rope transmission; Machine moulded and cut iron and steel gears for heavy service; Complete plant equipment; Sugar centrifugals. Engineers; Founders; Machinists.

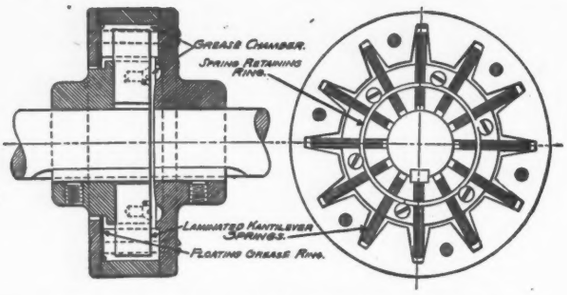


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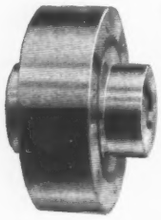
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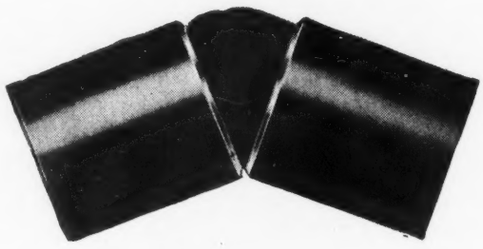
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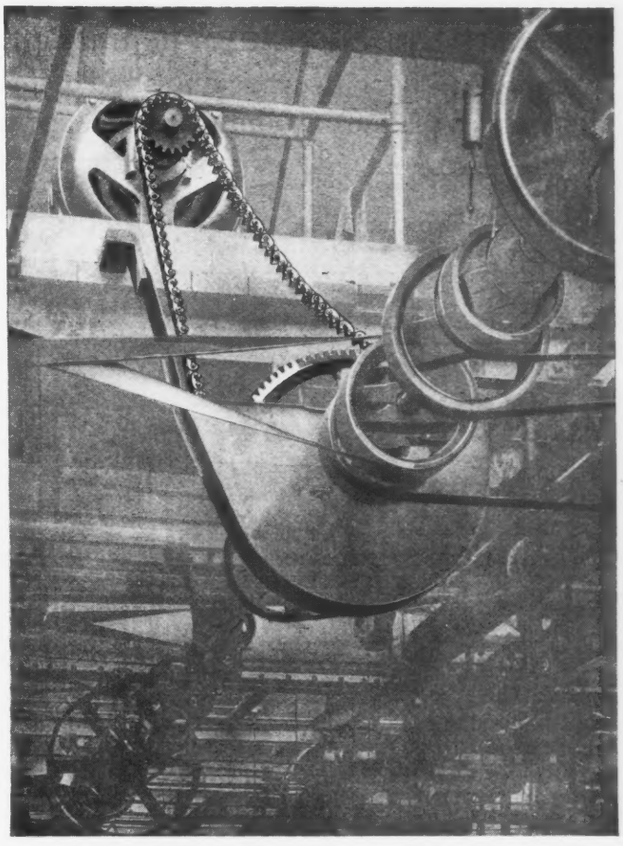
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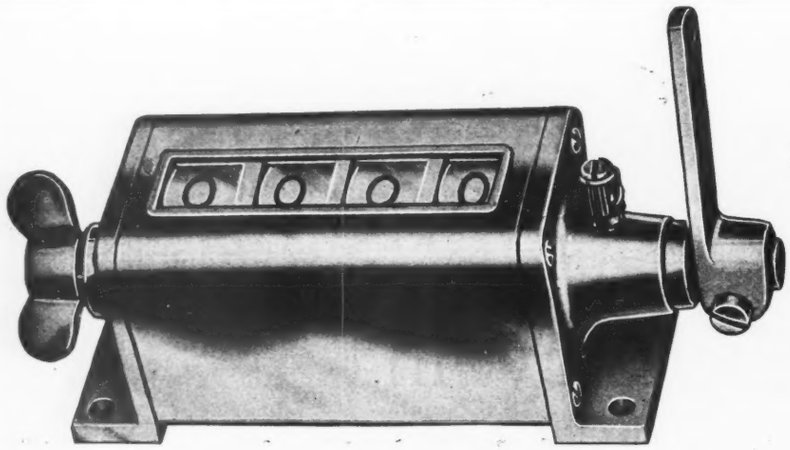
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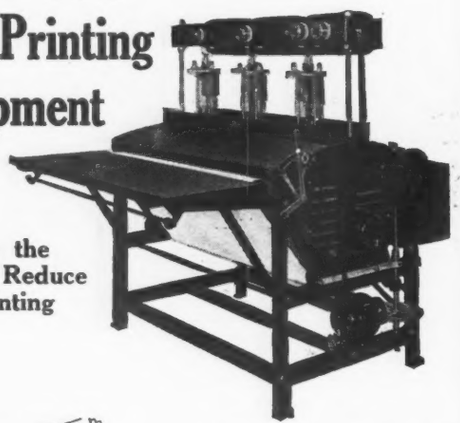
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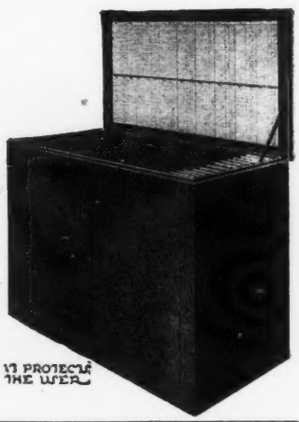
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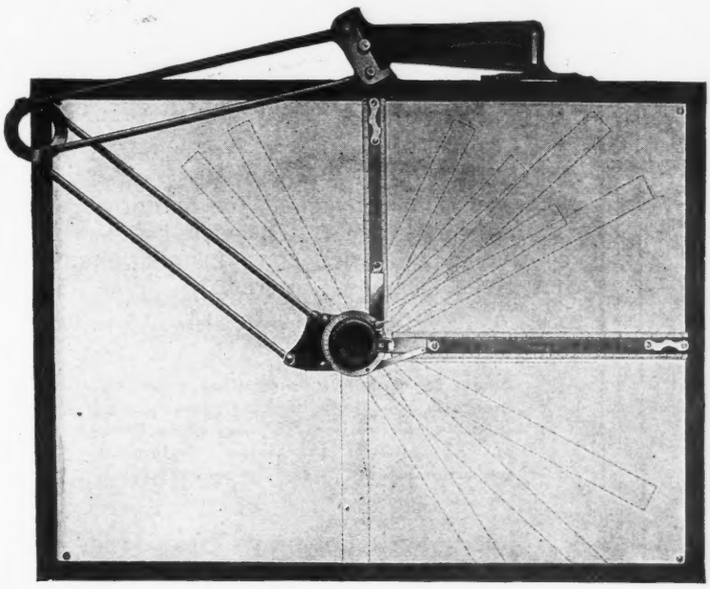
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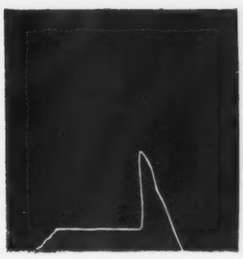


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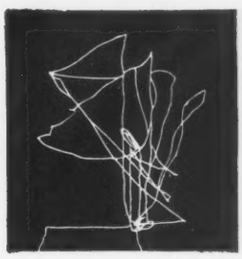
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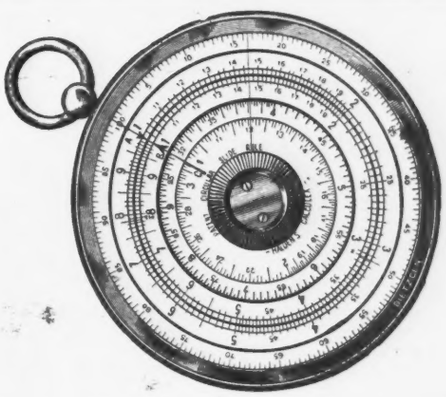
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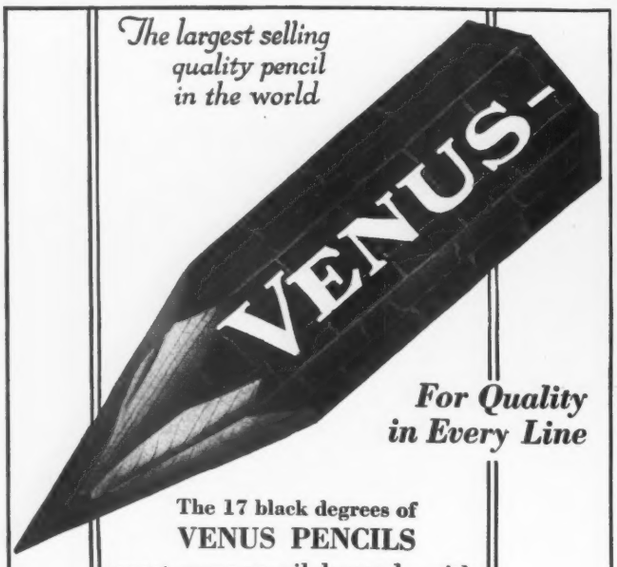
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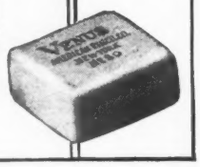
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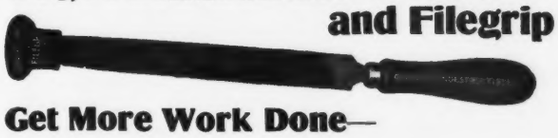
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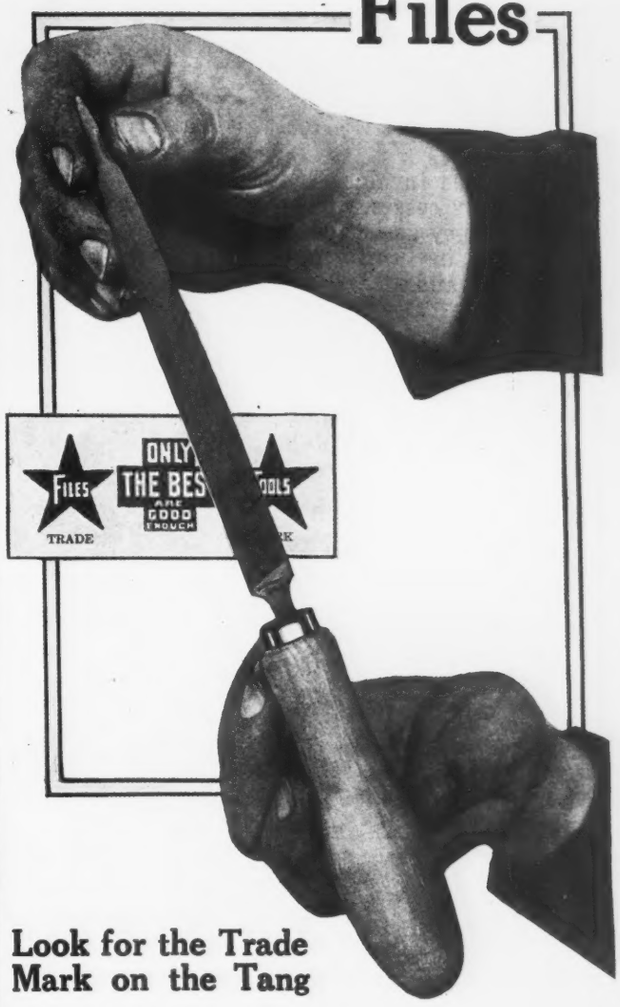
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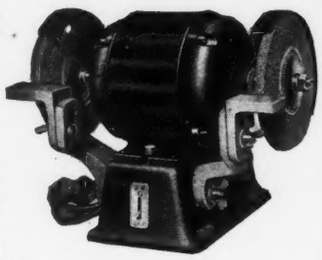
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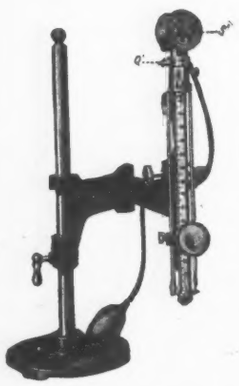
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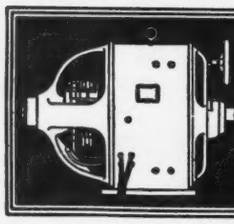
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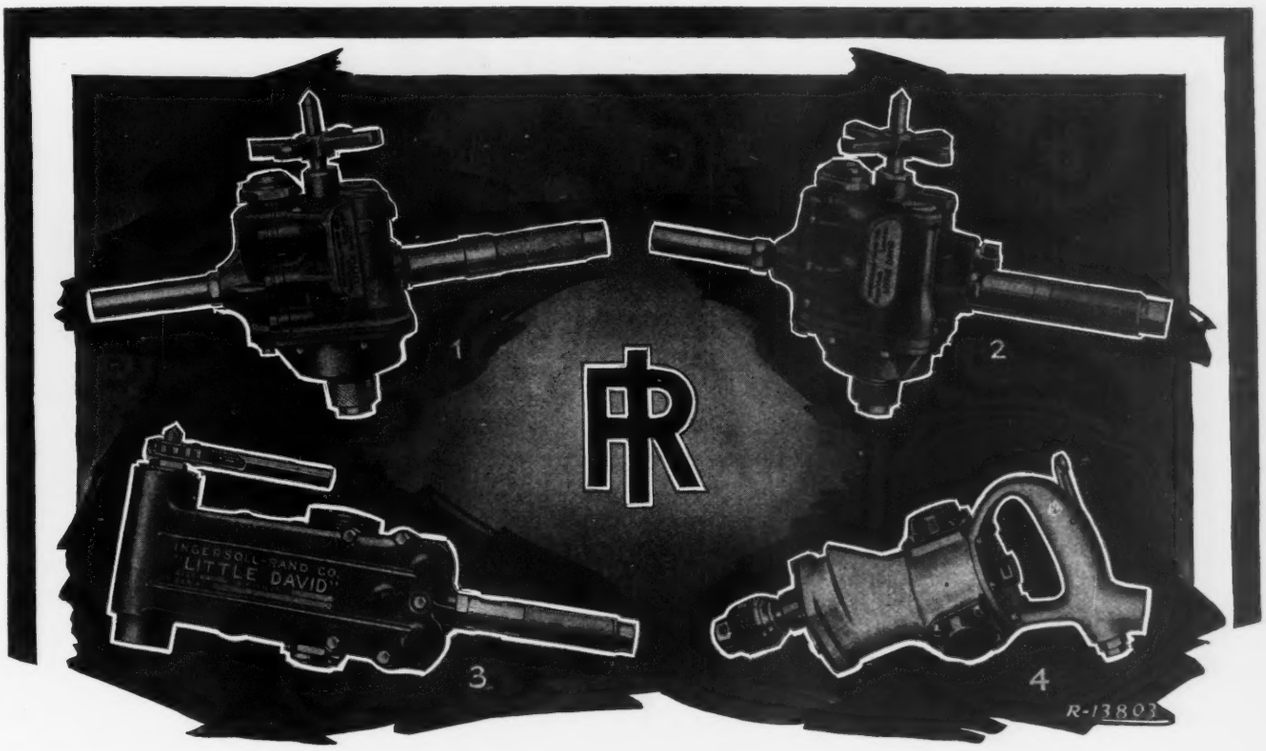
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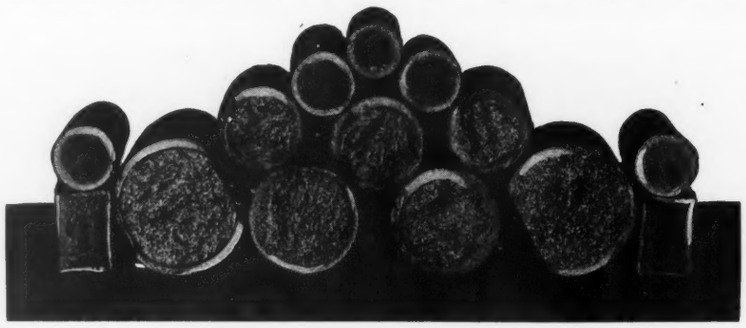
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Complete line of standard SPOT and BUTT welders.

Special machines designed for the rapid production of SPOT, BUTT, and SEAM welded work.

Write our nearest representative for catalog of standard welders.

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UNIFORM TEMPERATURE—MAXIMUM OUTPUT—MINIMUM FUEL COST

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DAVIS-BOURNONVILLE COMPANY
was merged with
AIR REDUCTION SALES COMPANY
on March 17, 1922

The Oxy-acetylene Welding and Cutting Products formerly manufactured by Davis-Bournonville Co., are now made and sold by Air Reduction Sales Co., under the trade name of "Airco-Davis-Bournonville" or "Airco-D-B."

(See Advertisement of Air Reduction Sales Co.)

The Duties of the Tool Dresser Are Simplified By the Installation of an

AMERICAN GAS FURNACE

Up to four months ago, the tool-dresser for H. W. Caldwell & Son, Chicago, Ill., forged, hardened and tempered all the lathe and planer tools for the shop with only a coal fire for heating. Now he uses the coal fire only for the forging heat; hardens the tools in an American Gas Furnace and tempers them, after quenching, in a lead pot—methods which he finds much quicker and more satisfactory than heating "by eye."



Consult us as to the best means of improving your heat treatment service—quality, output or cost. Our line includes: Gas Furnaces, Carbonizing Furnaces and Machines, Pressure Blowers, Heating Machines, Automatic Heat Controllers, Forges, Cylindrical and Oven Furnaces and every type of Gas Blast Furnace and Heating Machine for Industrial Uses.

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GIBB WELDING SERVICE
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GIBB INSTRUMENT CO.
Manufacturers of all types of Electric Welding Machines
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THOMSON ELECTRIC WELDING CO.
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Pioneer manufacturers of butt, spot and seam welding machines. Submit your welding problems to us.

TAYLOR SPOT WELD

Spot Welding For Profit

The Taylor Process improves output, makes more durable welds, lengthens the life of electrode points—makes more welds per dollar's worth of power.

The double electrode points do the trick.

Let us explain. Estimates from samples or blueprints

THE TAYLOR WELDER CO.
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WINFIELD METHOD
FLASH WELDING

© 1921 The Winfield Electric Welding Machine Co.

Our new book, describing Winfield "Butt" and "Flash" Welding—principles and applications—is ready for mailing. You can't afford to miss it. Is your name on the list?

THE WINFIELD ELECTRIC WELDING MACHINE COMPANY

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New York, 50 Church St. Cleveland, Ohio, 1017 Engineers Bldg
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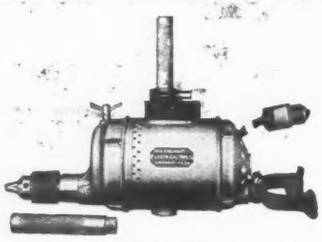
Save Time!

There are constantly occurring jobs in the shop where it proves more profitable to take the tool to the work than the work to the tool.

The Cincinnati

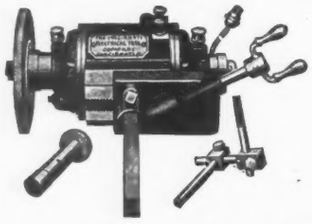
Portable Electrics are powerful, durable, compact. They stay on the job.

PORTABLE ELECTRIC DRILLS



¼" to 2½" capacity. Ball-bearing. Direct or alternating current.

"CINCINNATI" TOOL POST GRINDER



Direct Current, Alternating Current, or with Universal Motor. Furnished with or without Hand Feed.

BENCH GRINDER **FLOOR GRINDER**

Direct current.
Alternating current
Ball-bearing. Especially recommended for heavy grinding of all kinds; for buffing and for polishing.





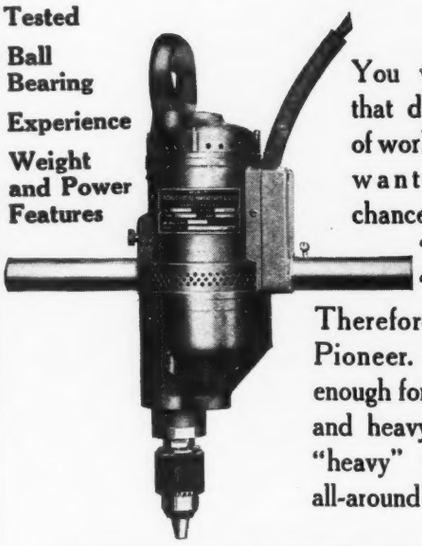
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Nine Times Out of Ten

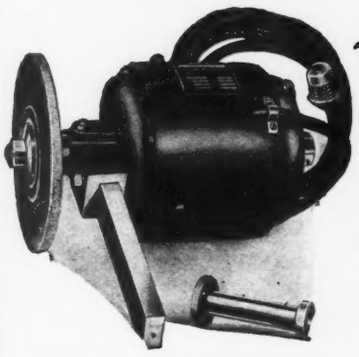
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Ball Bearing
Experience
Weight and Power Features



You want a drill that does all kinds of work. You don't want to take chances with the "light" or "heavy" drill. Therefore, get the Pioneer. It is light enough for "light" work and heavy enough for "heavy" work. The all-around tool.

BETTER BUY THE PIONEER
"It Will Do the Work"

Louisville Electric Mfg. Co.
INCORPORATED
C. E. WILLEY, President J. B. McFERRAN, Sec'y-Treas.
LOUISVILLE, KENTUCKY, U. S. A.



STOW Tool Post Grinder

For grinding Centers, Dies, Cutters and other equipment, this grinder is in a class of its own. Handles both Internal and Surface Grinding—hand feed or plain feed. Regular equipment ⅜"x6" wheel, internal grinding attachment, with 10 ft. flexible cord and plug to fit standard lamp socket. Write for details.

STOW MANUFACTURING CO., Inc., Binghamton, N. Y.
London Stock: 85 Queen Victoria Street

PORTABLE ELECTRIC DRILLS and GRINDERS

Complete line of sizes suitable for DC-AC and Universal Current
Tested to U. S. Navy requirements
THE NEIL & SMITH ELECTRIC TOOL CO.



Type L2U–¼" Universal Catalog No. 9
Cincinnati Ohio

HAND SNAGGING GRINDER
(Electric)



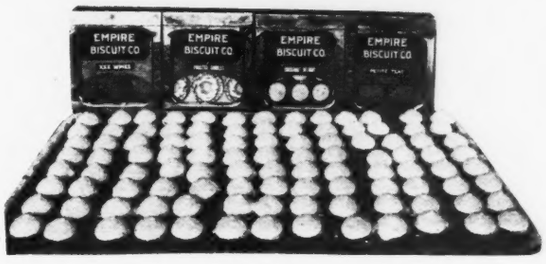
Light Weight . . 20 pounds
Large Wheel . . . 7" x 2"
High Power . . ¾ H.P. Max.

FORBES & MYERS, 178 Union St., Worcester, Mass.



Power King
Portable Electric Drills





Biscuits and Portable Drills!

You're wrong again! They don't use "Power King" to put holes in the biscuits. Empire Biscuit Company uses "Power King" to do the repair work on the batter machines, the ovens and conveyors and all the other apparatus —of which there is a lot in this Brooklyn factory.

"Power King" is the *Adaptable* portable drill—has two speeds, is powerful and rugged, with a big factor of safety and much reserve energy.

Let us send you detailed information about "Power King" and the new drill stand.

Jones, Mac Neal & Camp
INCORPORATED

FACTORY & GENERAL OFFICES
WARSAW, INDIANA.

Why Experiment? Use "Van Dorn"

ELECTRIC DRILLS AND GRINDERS



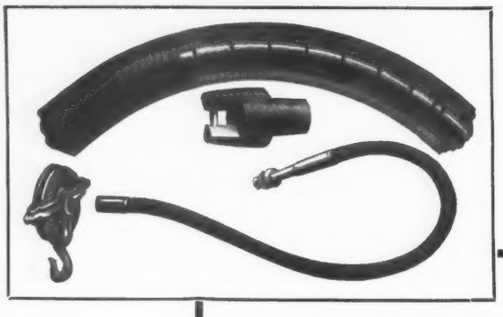
How do you measure Electric Tool worth?

Is it by *Reserve Power—Overload Capacity* —and *Freedom from Troubles* day-in and day-out after months of the hardest continuous service?

If so, then your idea of worth and ours is identical and the "Van Dorn" will just fit your demands.

Have you our catalog? It will interest you.

The Van Dorn Electric Tool Co.
Cleveland Ohio, U. S. A.



THE IDEAL FLEXIBLE SHAFT For Every Purpose

Can be made to meet requirements not possible in other shafts such as running in both directions, delivering the maximum power, and in any length of section up to eight feet.

All parts interchangeable, sections can be coupled together thereby making a shaft of the greatest possible length.

Write us about your flexible shafting requirements

GEM MANUFACTURING COMPANY
N. S., PITTSBURGH, PENNA.

GEM FLEXIBLE SHAFTING

DRILLS GRINDERS U S BUFFERS REAMERS

THE difference between a "U. S." and any other portable electric drill is instantly obvious to the mechanic who uses it—and shortly after to the man who employs him, when he sees his work speeded up and his men finishing the day with **far less fatigue.**

Write for catalog 20-E.

The UNITED STATES ELECTRICAL TOOL CO.
CINCINNATI, OHIO.

District Sales Offices and Service Stations

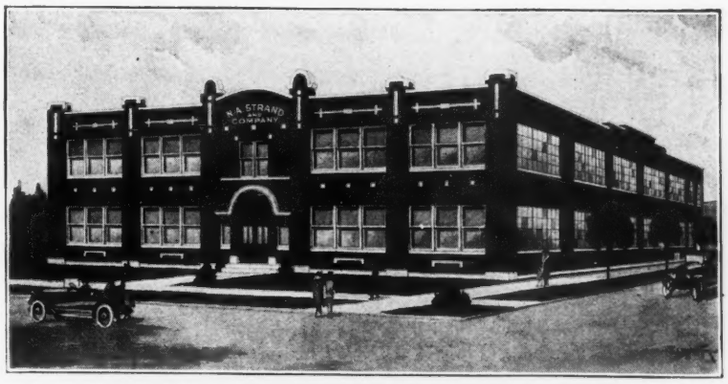
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UNITED STATES Portable Electric DRILLS

Complete stocks carried in all service stations.



The Good Mechanic Knows!



New Home of "Strand" Flexible Shaft Equipments.



MACHINES BUILT FOR SERVICE

Originators of the Three Speed Motor Countershaft Drive.
Made in several types and sizes.

Established Nineteen-Five

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TRADE MARK

We are now located in our new factory

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Eighteen years of clean, honest business methods have placed on our roll of satisfied customers a list of users which if published would require half the pages in this journal. Manufacturers from every part of the world are using the

STRAND Flexible Shaft Equipments

Manufactured by

N. A. STRAND & CO.

CHICAGO

Main Office and Factory: 5001-5009 North Lincoln St.

We Believe He Profits Most Who Serves His Customers Best

Haskins Equipment Also Provides an Efficient Tool Post Grinder



An extra spindle can be provided to take care of your lathe and surface grinding. This is an especially valuable feature in shops where there is not enough lathe grinding to warrant an additional equipment. The HASKINS is a good sturdy tool well adapted to this operation.

At other times the machine will be busy grinding castings, cleaning and scraping—occasionally drilling. It can do almost anything and we know you'll keep it busy.

We have a special proposition to make you now. You tell us about the work in your shop—if we can help you we'll say so and back it up with a factory demonstration. There is no obligation. We know that if we can save you money or time you'll keep our machine and pay for it—otherwise we wouldn't let you have it.

R. G. HASKINS COMPANY, 520 West Monroe St. CHICAGO, U. S. A.

Distributor for Pacific Coast: Mohr Bros. Co., 233 Pacific Bldg., San Francisco, Cal.

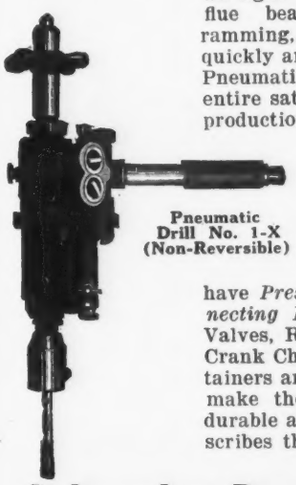
Thor

Pneumatic Tools



Light Chipping, Scaling and Cleaning Hammer

Wherever a difficult operation must be performed in close quarters—drilling in wood or metal, driving air-tight rivets, chipping, calking, flue beading, cleaning, scaling, ramming, etc., or lifting heavy loads quickly and safely—you'll find Thor Pneumatic Tools will not only give entire satisfaction but will improve production as well.



Pneumatic Drill No. 1-X (Non-Reversible)

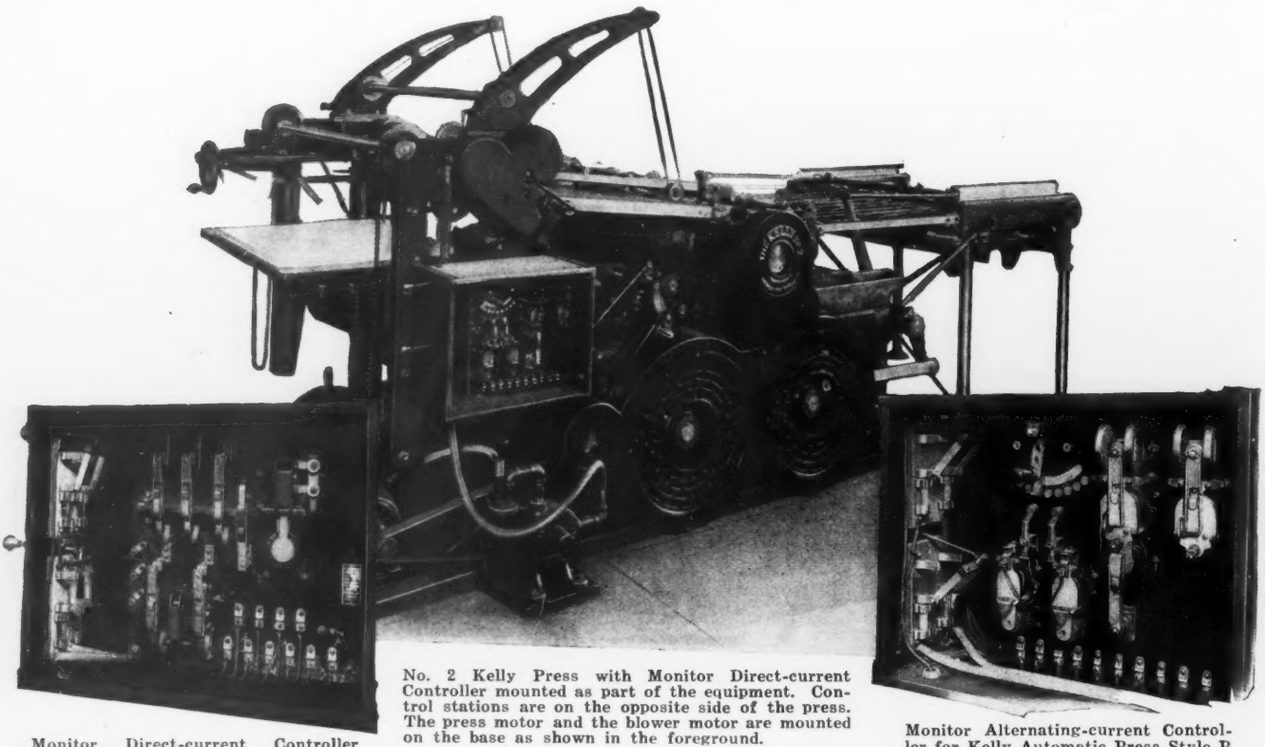
THOR DRILLS

have *Pressed Vanadium Steel Connecting Rods and Pistons*, Corliss Valves, Roller Bearings, removable Crank Chamber Plates, Bearing Retainers and other advantages which make them more than ordinarily durable and convenient. Catalog describes the whole line.

Independent Pneumatic Tool Co.

600 WEST JACKSON BLVD., CHICAGO

NEW YORK PITTSBURGH SAN FRANCISCO
DETROIT CLEVELAND BIRMINGHAM MONTREAL
PHILADELPHIA BOSTON ST. LOUIS



Monitor Direct-current Controller for No. 2 Kelly Automatic Press.

No. 2 Kelly Press with Monitor Direct-current Controller mounted as part of the equipment. Control stations are on the opposite side of the press. The press motor and the blower motor are mounted on the base as shown in the foreground.

Monitor Alternating-current Controller for Kelly Automatic Press Style B

Monitor AC and DC Controllers standard equipment for Kelly Presses

THE remarkable success of the Kelly Automatic Job Press Style B produced a demand for a larger size that has been met with the Kelly No. 2. This press, like the smaller model, was designed especially for high speed commercial and other printing. It provides unique facilities for quick make-ready and adjustment of ink to both press and feeder and is a time-saver on both long and short runs.

The automatic feeding mechanism is fool-proof and does not require attention except when paper stock is exhausted, or when the machine is automatically stopped due to something going wrong with the paper.

The controllers for the No. 2 press were specially designed by the Monitor Controller Company, and are standard equipment on all Kelly presses. They provide for push-button start and stop, and automatic stop in case of necessity.

Electric brake, automatically applied by the controller, acts so quickly that the cylinder will stop from full speed within one revolution.

There are three control stations on the press—an automatic trip station to stop the press and the blower; a three-button main control station mounted near the cylinder, one button providing start for the blower motor, one for the press motor and one to stop both motors simultaneously, and a stop station mounted at the delivery end of the press, which also stops both blower and press motors.

For direct-current operation the press is driven by a 3-hp. motor and the blower by a ½-hp. motor. For alternating-current operation the press is driven by a 4-hp. Polyphase Slip-ring Induction Motor and the blower by a ½-hp. Induction Motor.

The Monitor Controller Company is equipped to design and build controllers for any type of motor service, either direct-current or alternating-current and to meet any requirements of speed adjustment or variation.

Monitor Controller Company

BOSTON BUFFALO CHICAGO CLEVELAND DETROIT NEW YORK PHILADELPHIA PITTSBURGH ST. LOUIS NEW ORLEANS BIRMINGHAM

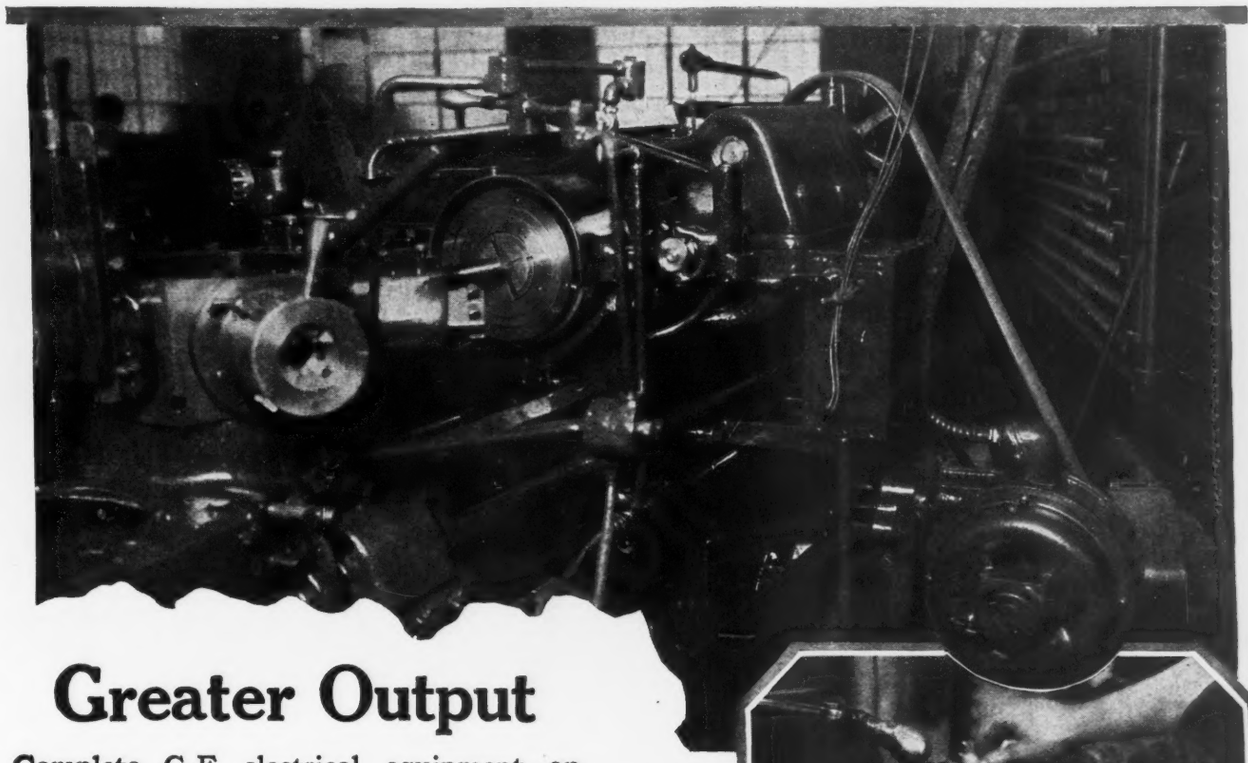
BALTIMORE - MARYLAND

Bulletin 1006 describes and illustrates Monitor Control for machine tools. Ask for it.

The Original "Just Press a Button" System

82-3520

In the Machine Shop



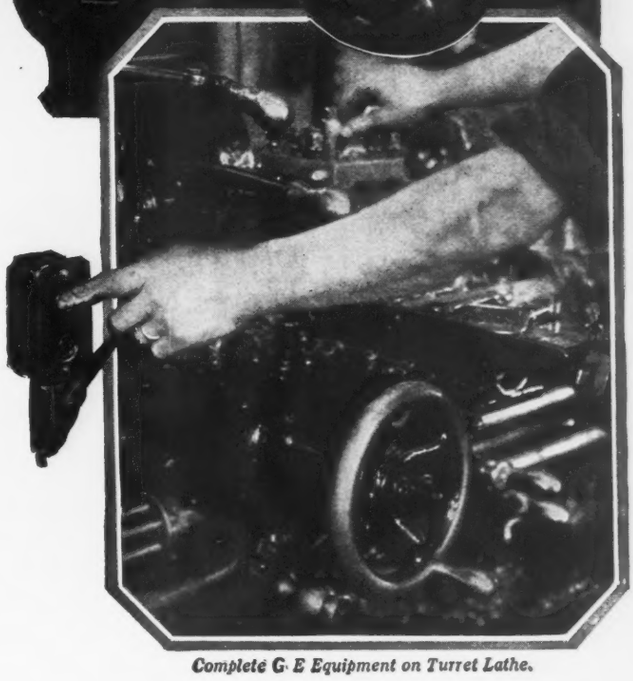
Greater Output

Complete G-E electrical equipment on turret lathes gives the operator instantaneous control, saves time between set-ups and eliminates unnecessary steps.

Notice the "finger tip" control obtained with G-E Push Button Station and Magnetic Switch on this modern turret lathe. The operator can start and stop the machine without moving a step—every move becomes a productive operation.

With G-E Motors, Controllers and Accessories installed as a complete operating unit —your quantity production machines can be operated more continuously, and can be made to produce the maximum number of finished parts per working day.

Ask the nearest G-E Sales Office for full information.

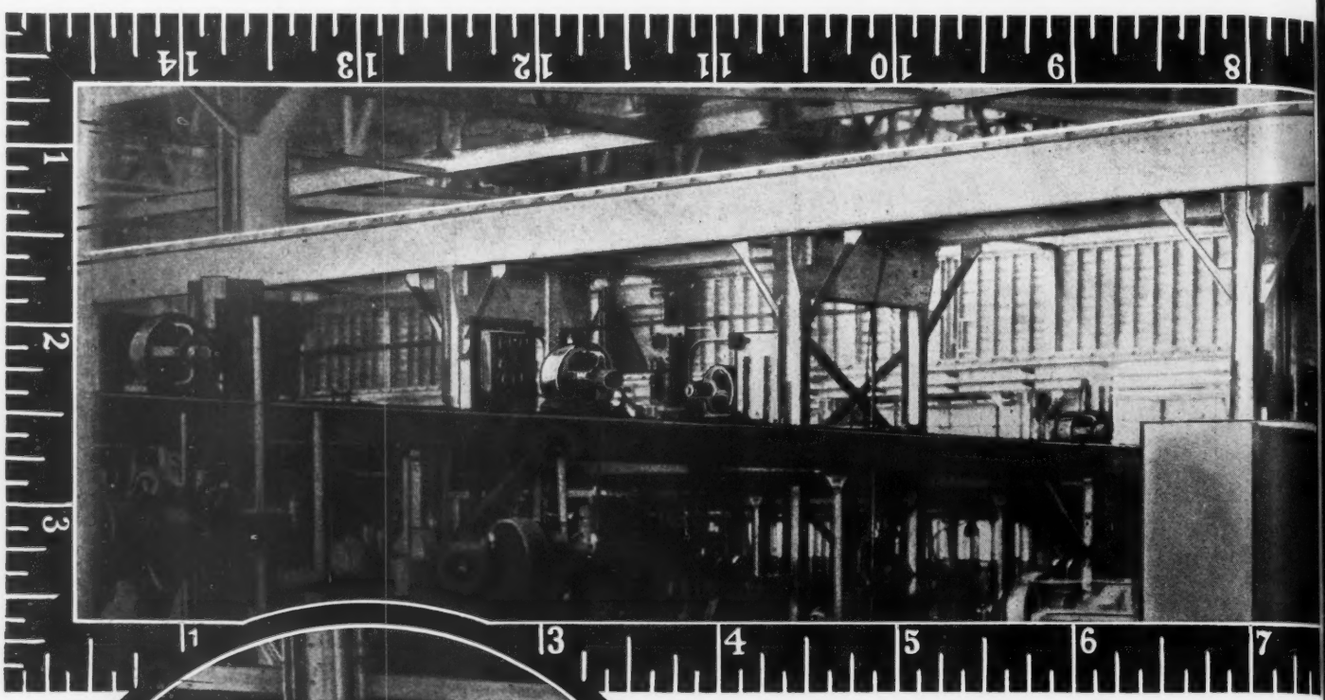


Complete G-E Equipment on Turret Lathe.

General Electric Company
Schenectady, N. Y.
Sales Offices in all large cities.

GENERAL ELECTRIC

43B-783





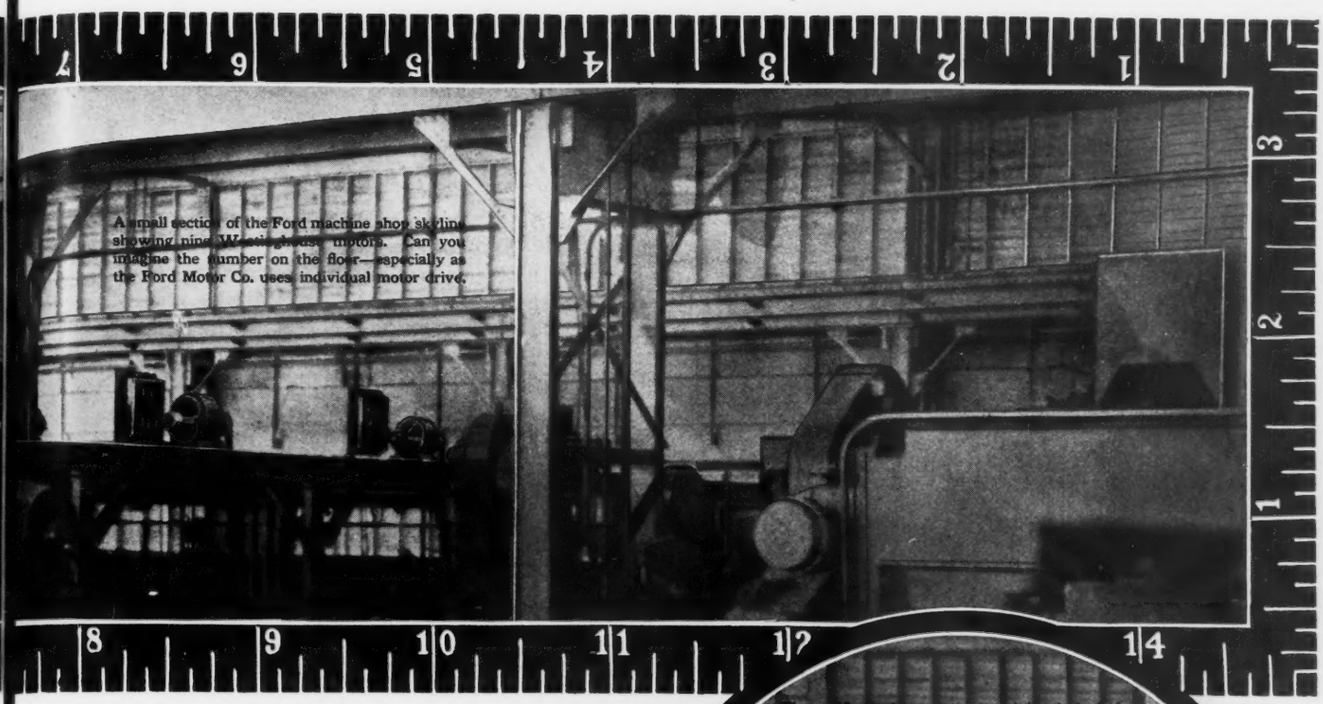
The machine shop at the River Rouge Plant of the Ford Motor Company, represents the latest Ford practice in quantity production. Complete castings for five hundred Fordson tractors are machined in this department every day. This output, however, represents only a fraction of the work handled, for all of the T-400 (Ford car cylinders) are completely machined here and shipped to Highland Park, Mich., for assembly. There are five thousand of these cylinders machined at River Rouge every twenty-four hours.

Every inch a tool

Westinghouse Type SK direct-current commutating-pole motors represent the most advanced design in direct-current machines for general, constant and adjustable-speed power purposes. They are especially suitable for driving machine tools where the load is frequently started, stopped and reversed. The large number of SK motor-driven machine

Westinghouse Electric
East Pittsburgh,

Westinghouse

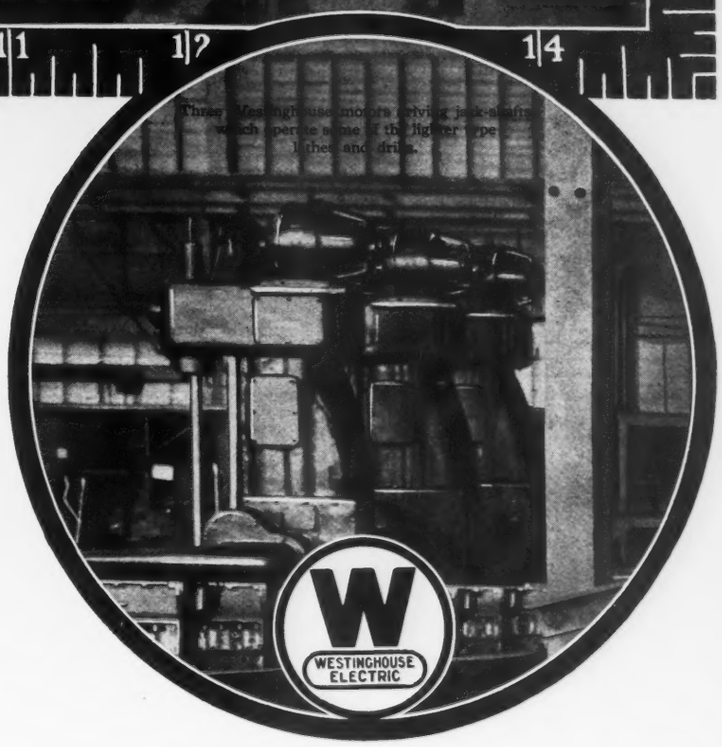


A small section of the Ford machine shop skyline showing nine Westinghouse motors. Can you imagine the number on the floor—especially as the Ford Motor Co. uses individual motor drive.

a machine motor

tools throughout the country is a tribute to this type of motor. It is proof of the correctness of its design.

Some of the special features of the Westinghouse Type SK Motors are: Great mechanical strength, excellent commutation, dustproof bearings, high operating efficiency and absolute reliability at all times.



Three Westinghouse motors driving jack-shafts which operate some of the lighter type lathes and drills.

The huge output at Highland Park depends entirely upon the continued and uninterrupted operation of the River Rouge machine department. Hence, nothing has been left undone to provide the most efficient and reliable apparatus for performing the work. Westinghouse motors overwhelmingly predominate and are to be seen by the hundreds. These photographs indicate somewhat how thoroughly Ford output depends on Westinghouse performance.

& Manufacturing Company
Pennsylvania

Westinghouse



Write for Details

Three Minutes to Dry 200 Pounds

The GLOBE Tumbling Barrel, used for drying small parts at the Kelsey Wheel Company, Detroit, Mich., saves time and money on a necessary operation; it would take much longer and cost a lot more to get the same result by any other method. The ring clamps shown are loaded in lots of 200 pounds after zinc plating and three minutes' tumbling with sawdust dries them thoroughly.

Four years' service has shown GLOBE Tumbling to be convenient, efficient and profitable; the barrel is always ready for work and has never been out of order.

Polishing, Plating, Drying, Cleaning—there's a GLOBE Tumbling Barrel to get profitable results on every operation

THE GLOBE MACHINE & STAMPING COMPANY

1250 West 76th Street CLEVELAND, OHIO

Manufacturers of Metal Stampings of Quality

FOREIGN REPRESENTATIVES: J. Horstmann, 81-83 Rue Saint Maur, Paris France; 46 Rue Juliette-Recamier, Lyons, France

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Industrial
Agricultural
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Residential

A type for every service. Bulletins on request.

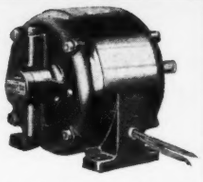
THE GOULDS MANUFACTURING CO.

SENECA FALLS, N. Y.

Branches or agencies in all principal cities.

GOULDS

Interchangeable Frames



Master Motors Must Make Good

IF there is one thing more than any other that has largely contributed to the general acceptance of Master Motors, it is that they are built with the viewpoint of the appliance manufacturer always in the foreground.

The interchangeability of Master frames is an example of how carefully every point has been considered. Master frames are interchangeable and the base dimensions are uniform for D. C. and A. C. of the same horsepower ratings. Many parts are also interchangeable.

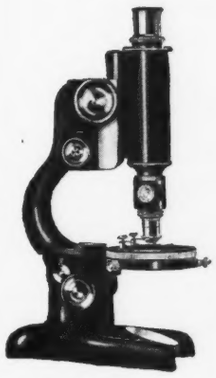
If you buy motors or design electrically driven products, you will find our Data Book full to the brim with helpful suggestions. Write for it and other literature today.

THE MASTER ELECTRIC CO., 448-1st St., Dayton, O.

MASTER
40° GUARANTEED 40°
MOTORS

Repulsion-Induction 1/8 to 1½ H.P. *Polyphase Direct Current*

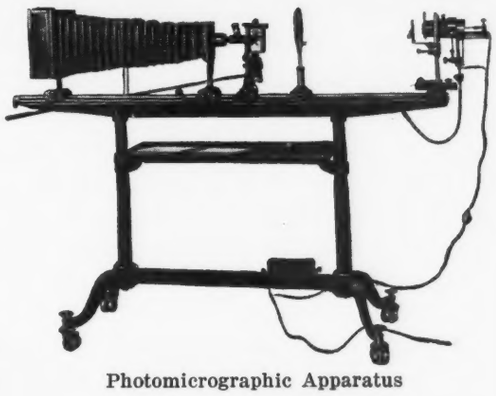
Bausch & Lomb Optical Apparatus for Inspection



Metallurgical Microscope



Binocular Microscope



Photomicrographic Apparatus



Contour Measuring Projector

BAUSCH & LOMB OPTICAL CO.
Rochester, N. Y.

NEW YORK WASHINGTON CHICAGO
SAN FRANCISCO LONDON

Optics in Industry

IN the development of modern industry, the inspection and test of materials used in manufacture—and of the finished product—have assumed great importance. For finality of conclusion and accuracy of result, optical tests are certainly the most satisfactory.

Chemical tests may show the correct proportion of the ingredients, in iron or steel for instance, but the only way in which the condition or physical structure can be determined is by an optical examination. This is true with many other materials, also.

THE MICROSCOPE—Revealing defects and imperfections visible only in a greatly magnified image.

PHOTOMICROGRAPHIC APPARATUS—For making permanent photographic records of the findings of the microscope; called Metallographic Apparatus when designed for photography of metals.

CONTOUR MEASURING PROJECTOR—Invaluable for the visual inspection or check of the contours of screw threads, gears, cutting tools, and the like.

Our Scientific and Technical Bureaus will be glad to suggest ways in which you can better your inspections by the application of optical instruments.

Makers of Microscopes, Photomicrographic Apparatus, Projection Apparatus, Binoculars, Telescopes, Ophthalmic Lenses, and Other High-grade Optical Products.

AIRCO
DAVIS
APPARATUS
DAVIS-BOURNONVILLE CO.

ANYTHING AND EVERYTHING
FOR OXYACETYLENE WELDING AND CUTTING



SERVICE

ECONOMY

Public faith in a product is a reflection of faithful performance. Thus, consistently, have Airco Oxygen and Airco Acetylene built up good-will.

Write for Airco booklet:
"Anything and Everything for Oxyacetylene Welding and Cutting"

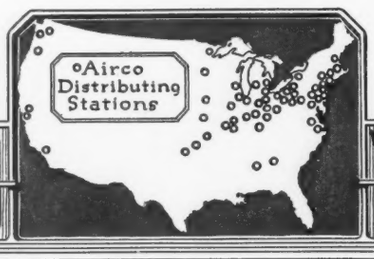
AIR REDUCTION SALES COMPANY

Manufacturer of Airco Oxygen — Airco Acetylene — Airco-Davis-Bournonville Welding and Cutting Apparatus and Supplies, Acetylene Generators, and Specially Designed Machines for Automatic Welding and Cutting— Nitrogen, Argon and other Airco Atmospheric Gas Products

Controls the manufacture and sale of National Carbide

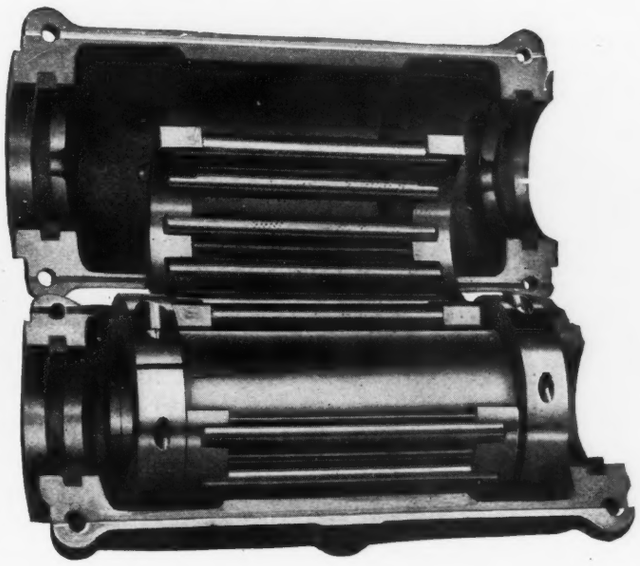
Home Office: 342 Madison Avenue, New York, N.Y.

Airco District Offices, Plants and Distributing Stations conveniently located throughout the Country.



"Airco Oxygen and Acetylene Service is Good Service"

7,000 Sells Bearings in the Dodge Plant



American Agricultural Chemical Company has installed Sells Bearings in its 25 plants.

United Shoe Machinery Company uses Sells Roller Bearings

So do

French, Shriner & Urner and the Borden Condensed Milk Company

also

The American Car and Foundry Company

and

Aunt Jemima Mills Company and the Gillette Safety Razor Company.

We could continue this list until we had mentioned thousands of concerns

—all using Sells Roller Bearings.

If you, too, are ready to begin saving coal or power we'll be glad to tell you how little it will cost to install Sells Roller Bearings with the patented sleeve in your plant.

Shall we send our booklet "Anti-Friction Power Transmission"?

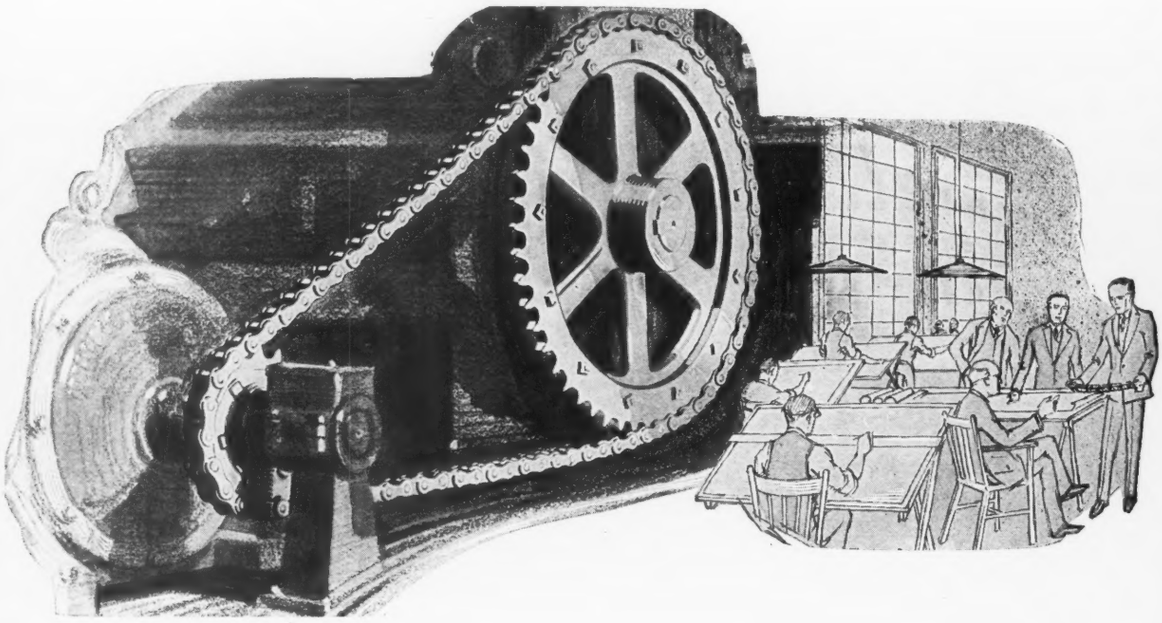
Royersford Foundry & Machine Company

54 N. 5th Street

PHILADELPHIA

SELLS Roller Bearings

And see that you get the Sells; it's marked. The bearing that is past any experimentation.



Baldwin Chain Drives and Sprockets Turn the Wheels of Industry

Steel Roller Chain.

Steel Block Chain.

Malleable Detachable Chain.

New Steel Replacement Series.

Sprockets both Cut and Cast.

Baldwin Transmission Engineers will help you select the standard system best suited to your needs or will develop special drives to meet them.

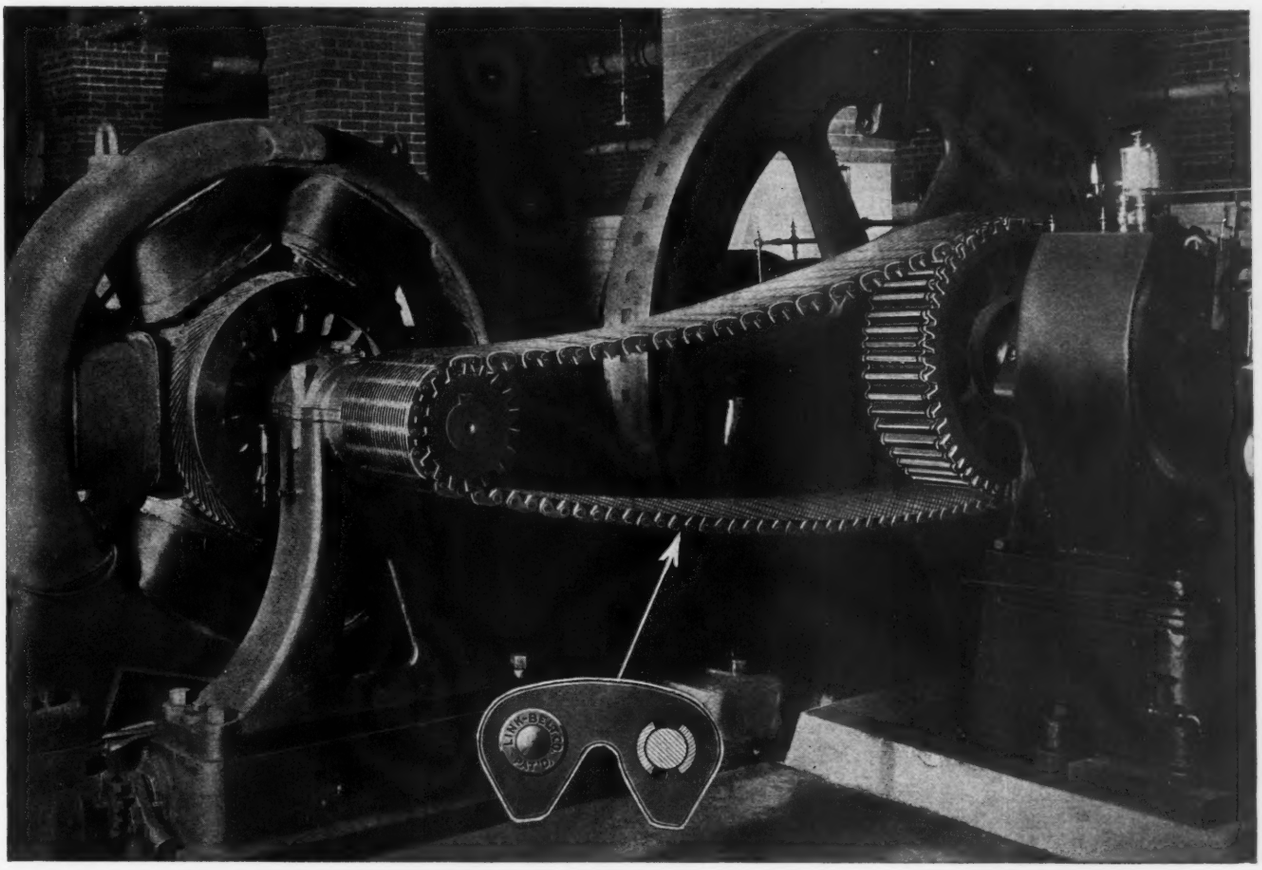
Baldwin Roller Chains and Sprockets solve transmission and conveying problems in practically every major industry. Experience has shown that special chains must be furnished to meet unusual conditions. We study each problem separately, carefully taking into consideration all varying conditions of loads, shocks, distances between centers, etc. Lumber, steel, paper, cement, textile mills, etc., secure continuous production with minimum power waste by using the *right* Baldwin Drive.

Dependable service cuts production costs, long wearing qualities reduce replacement charges to almost nothing.

BALDWIN CHAIN & MFG. COMPANY

WORCESTER, MASS.

H. V. GREENWOOD, General Western Representative
Peoples Gas Building, Chicago, Ill.



Since 1903—20 years ago—

this Link-Belt Silent Chain Drive has been operating an air compressor at the La Salle St. Station, Chicago.

This drive has required less than $5.00 repair per year.

It is still good for many years economical service—even though an air compressor is a comparatively difficult thing to drive. Such is the service rendered by Link-Belt Silent Chain Drives.

Learn more about this effective, quiet, drive for all kinds of machinery and lineshafting. Send for our 144-page price-list data book No. 125. It is a handbook of silent chain practice. Return the coupon.



LINK-BELT COMPANY
910 S. MICHIGAN AVENUE. CHICAGO

Please send postpaid—Link-Belt Silent Chain Data Book No. 125.

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Firm _____

Street _____

Town _____

State _____ Machinery, N. Y.—1259

LINK-BELT COMPANY

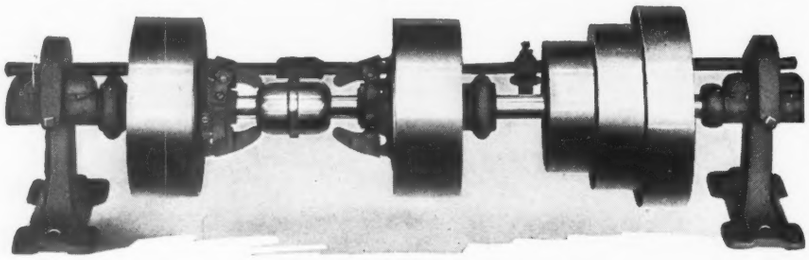
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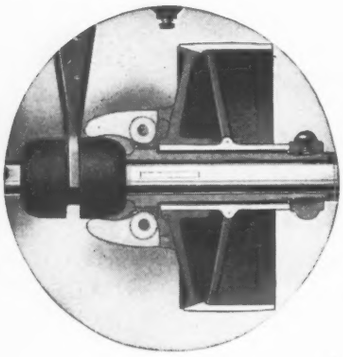
H. W. CALDWELL & SON CO., CHICAGO NEW YORK, Woolworth Bldg. DALLAS, TEXAS, 709 Main St.

LINK-BELT
SILENT CHAIN DRIVES

Bardons & Oliver Friction Countershafts

Endorsed by 20 Years' Successful Performances





Seven Sizes—Two and Three Speeds

Are your countershafts all doing their full duty? If not, look up the countershafts in the B & O section and check up their records as compared with the rest. If you haven't any in your factory drop in on one of your neighbors who has. Get his opinion and size them up for yourself.

We're satisfied to have B & O Countershafts judged by their performances—they've been making good for 20 years.

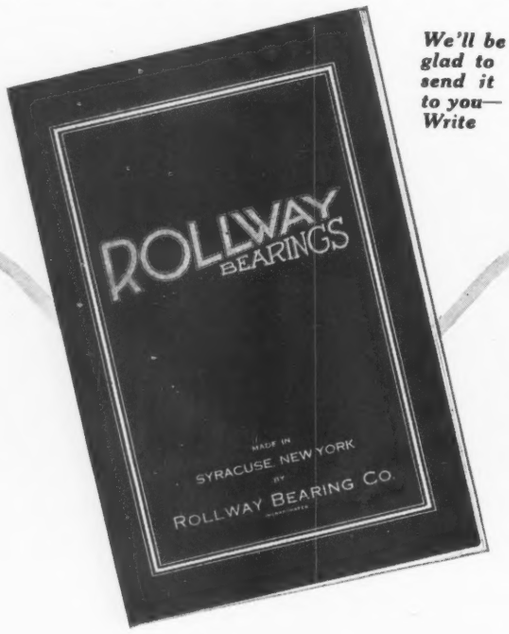
Circular outlines their main features of superiority and describes the seven sizes—7″ to 18″—sold complete or in parts. Write for it today.

BARDONS & OLIVER
***of* Cleveland, Ohio**

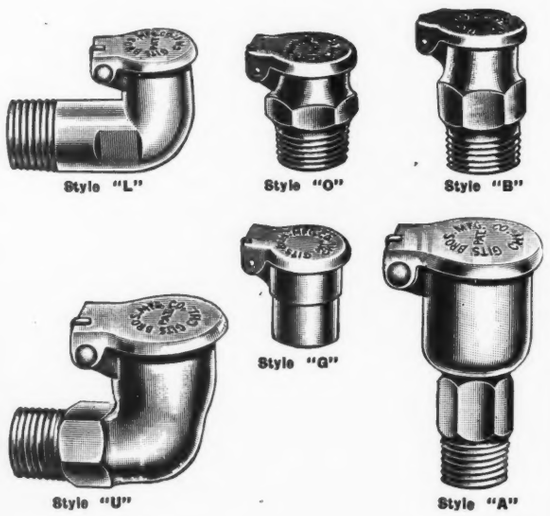
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ROLLWAY
Maximum Type
Bearings
in this
New Catalog

A bigger, more complete catalog—you'll want a copy if you use anti-friction bearings or if you need bearings for particularly severe duty. Contains many facts and figures for designers and engineers.

ROLLWAY BEARING COMPANY, INC., Syracuse, New York



We'll be glad to send it to you—Write



GITS OIL CUPS

Give perfect satisfaction where others fail. State style and size in which you are interested, and we will send free sample and catalog.

Gits Bros. Manufacturing Company
1901 S. Kilbourne Avenue CHICAGO, ILLINOIS

THE TEXACO LINE

Texaco Lubricants are carefully prepared to meet practical conditions and each lubricant is carefully tested in many plants before it is marketed for the purpose intended.

TEXACO MACHINE OILS
TEXACO CUTTING OILS
TEXACO SOLUBLE OILS
TEXACO THUBAN COMPOUND
For light fast-running enclosed gears

TEXACO CRATER COMPOUND
A heavy mineral lubricant for lubricating heavy gears, wire rope, chains, etc.

TEXACO CUP GREASES
TEXACO MOTOR AND GENERATOR LUBRICANTS
TEXACO TURBINE OILS
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TEXACO CYLINDER OILS
A grade for every condition of heat, pressure, character of water, speed, etc.

In short, we can furnish you with a scientifically correct lubricant that will increase the operating efficiency of any of your machines or power units.

These lubricants are in use in numbers of the most carefully operated machine shops and power plants not only in this country, but throughout the world.

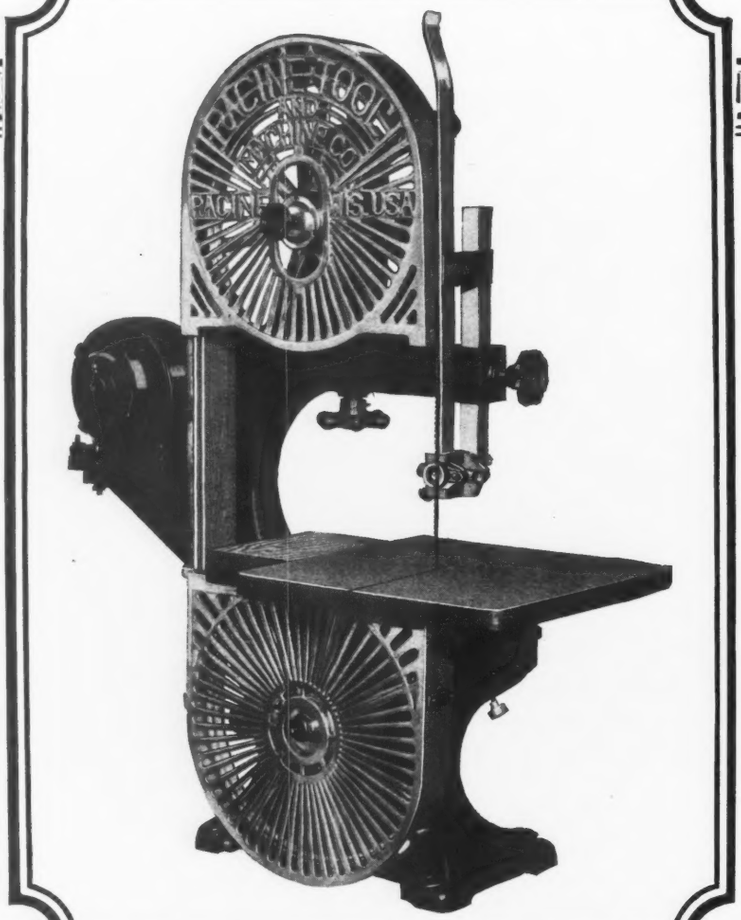
We shall be glad, at all times, to answer any question relating to the use or application of lubricants, and we would thank you to address inquiries to our nearest district office.

THE TEXAS COMPANY, U. S. A.

Texaco Petroleum Products

Dept. F, 17 Battery Place, New York City

Atlanta	Chicago	El Paso	New Orleans	Oklahoma City
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A Two and One-half Mile Cut Through Brass with ONE Saw Blade —and the Blade is Still Running

More than 40,000 pieces of 1¼" brass tubing have been cut with one saw blade and the blade is still good—a wonderful testimony to the smooth, vibrationless operation of the

RACINE DUPLEX BAND SAW

The Racine Duplex Band Saw is an accurate, rugged, practical machine tool designed by experts in metal cutting machinery. Ball-bearing mounted wheels, spring tension, and convenient adjustment for truing wheels add to the life of the blades and assure better production. Speed changes and special design fit it to handle wood, soft metals or steel. Compactly built with individual motor drive —can be located at the point most convenient to the work.

Use "Racine" H. S. Wood and Metal Band Saw Blades.

Bulletin giving complete details on request.

"RACINE" High Speed Metal Cutting Machines

Make Blade Last Ten Times Longer

—saw lifts positively on every return stroke —cuts on draw stroke only. Blades last ten times longer, work is smoother and more accurate.

Send for complete bulletin and sample, cut from 5½" bar that shows quality of work.

Use "Racine" H. S. Tungsten Power and Hand Hack Saw Blades.

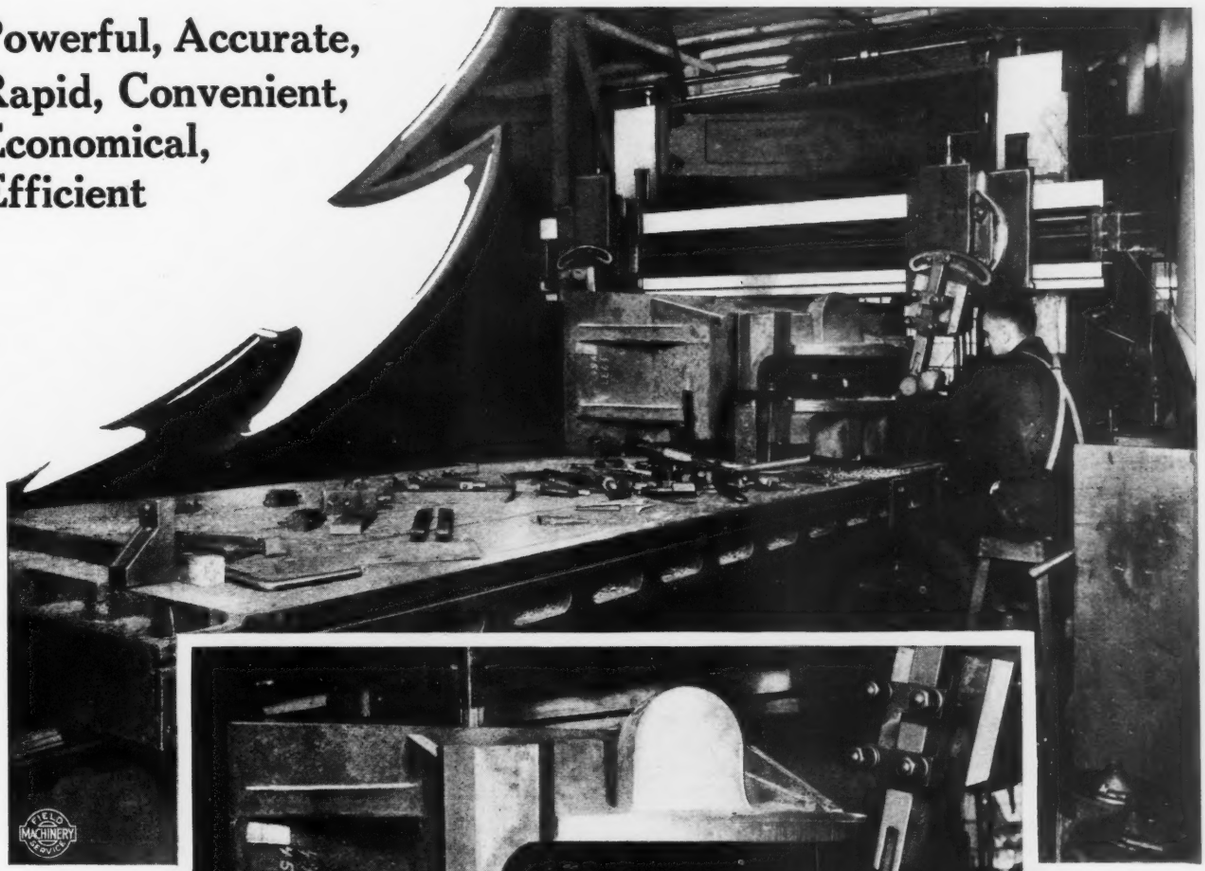
Racine Tool & Machine Co.

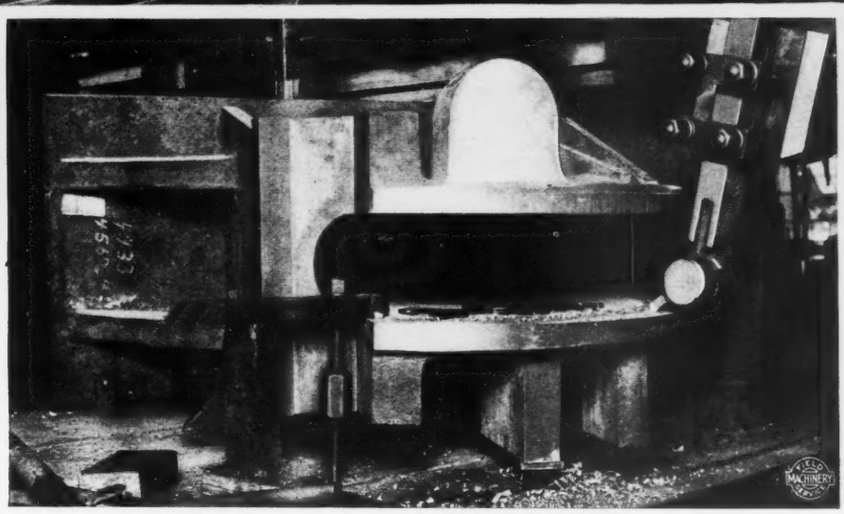
250 15th Street Racine, Wis., U.S.A.

"STANDARD THE WORLD OVER"

ROCKFORD PLANERS

**Powerful, Accurate,
Rapid, Convenient,
Economical,
Efficient**





In the Toledo, Ohio, plant of the City Machine & Tool Company this Rockford Planer, 72″ x 48″ x 18′, is rendering a high degree of service machining large tool work. It takes heavy cuts, accurately. In the picture the Rockford is shown finishing the inside portion of a steel combination blank holder and heading die for producing automobile fenders.

Rockford Planers are built in sizes from 24″ to 54″, any length and any desired head equipment. It will be well worth your while to get posted on Rockford Planers and the work they do.

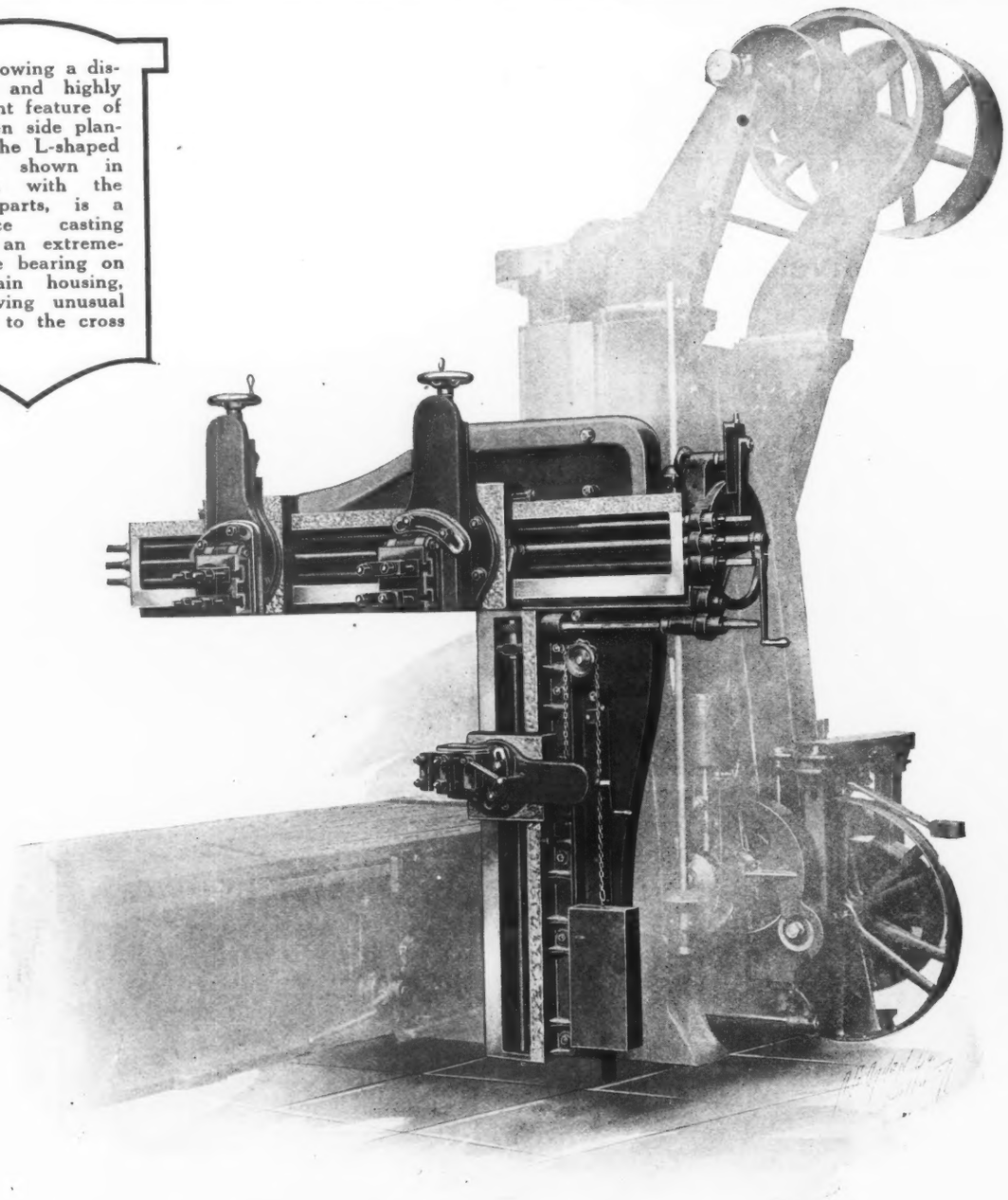
Send for the Catalog

ROCKFORD MACHINE TOOL COMPANY

Kishwaukee Road **ROCKFORD, ILL., U. S. A.**

SHAPERS—PLANERS—DRILLS

View showing a distinctive and highly important feature of our open side planers. The L-shaped casting, shown in contrast with the other parts, is a one-piece casting having an extremely large bearing on the main housing, and giving unusual rigidity to the cross rail.



An Important Feature in Detrick & Harvey Open Side Planers

BETHLEHEM Detrick & Harvey Open Side Planers are noted for a feature in design that is of greatest importance in giving satisfactory service over long periods.

A fundamental requirement of planer construction is rigidity in the cross rail and "squareness" with housing and table. This is particularly so in the open side type of planer in which the outer end of cross rail has no housing bearing, and depends for stiffness on cross rail strength and bearing of inner end on housing.

With cross rails having limited or small bearing area on housing, wear occurs, with consequent chattering while working and loss of alignment with bed and table.

How the distinctive Bethlehem Detrick & Harvey feature overcomes these difficulties is explained in our Catalog P-1.

Examples of Bethlehem Detrick & Harvey Open Side Planers that have been in use over thirty years and are still giving excellent service is indisputable evidence that this design is superior.

BETHLEHEM STEEL COMPANY
General Offices: **BETHLEHEM, PA.**

BETHLEHEM

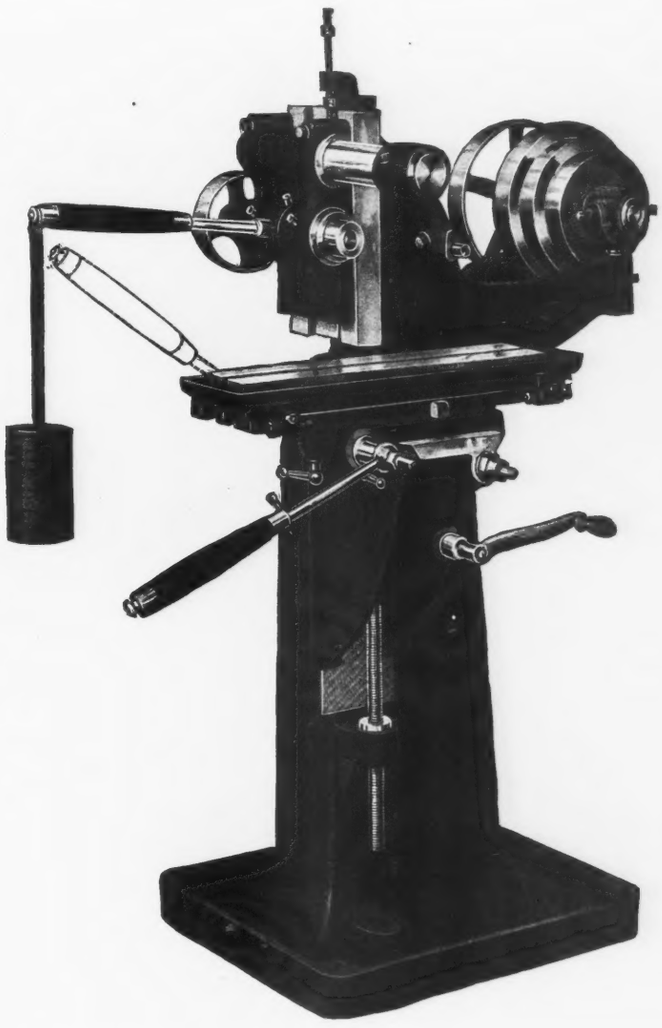
"WHITNEY"
HAND MILLING MACHINE

THOUSANDS IN USE

Note that the
"WHITNEY"
is different from the usual type of Hand Milling Machine.

The
Sliding Head
is its distinctive feature, giving advantages possessed by no other type of Hand Miller.

The spindle is driven by interchangeable side pulleys, giving six spindle speeds with three grade cone and four with two grade cone.



PROMPT DELIVERIES

THE WHITNEY MFG. COMPANY
HARTFORD, CONNECTICUT

CHAINS KEYS AND CUTTERS HAND MILLING MACHINES

NEW YORK
L. C. Biglow & Co., Inc.
243 W. 55th St.

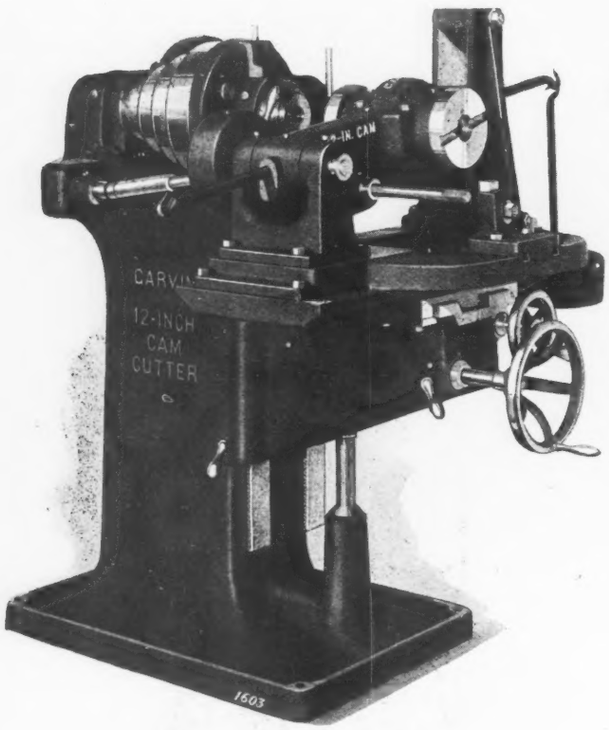
LONDON, ENG.
Burton, Griffiths & Co., Ltd.
64 Vauxhall Bridge Road

PARIS, FRANCE
Fenwick Freres & Co.
8 Rue de Rocroy

For Production

The one sure way to profits today is via the route of lowered costs. Which means just this—real production at every turn and corner.

GARVIN
Cam Cutting Machines



12¹ Cam Cutting Machine
Arranged for cutting face cams

Simple and Convenient to operate

It is not necessary to purchase a complicated machine to take care of your cam or form milling as GARVIN manufactures a line of Cam Cutting Machines that will meet your requirements.

Easily changed for cutting either Face or Barrel cams, and will also take care of large variety of form milling.

We will be glad to go into details with you.

THE GARVIN MACHINE COMPANY, Spring and Varick Sts. **NEW YORK**

Duplex Drills and Mills. Bright Internal Grinders. Tappers, Screw Machines, Screw and Die Slotters, Hand and Index Millers.

GARVIN

Spring Coilers. Production, Universal, Plain, Vertical and Slot Millers. Profilers, Cam Cutters, Bench Cutter and Surface Grinders.

GLEASON

BEVEL GEAR TESTING MACHINE

NEW DESIGN



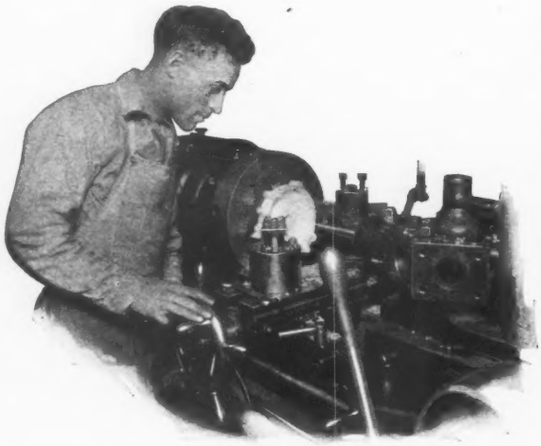
18" Bevel Gear Testing Machine

The machine used for testing the running qualities of Bevel or Spiral Bevel Gears must be rigid, unchanging in alignment, and convenient to operate.

This New Design 18-inch Bevel Gear Testing Machine is built with hardened and ground spindles running in adjustable taper bronze bearings lubricated by continuous flow of oil. The compensating locking lever brings both binder bolts to equal tension with one motion of hand lever.

GLEASON WORKS, Rochester, N.Y.

MACHINISTS OR WRESTLERS?



Are your Turret Lathe operators devoting their entire time to the production of finished pieces or are they wasting precious moments wrestling with machines that are difficult to operate?

Motions wasted are moments lost!

Wasted labor means lost production. It means a higher cost for getting things done.

Millholland Turret Lathes Are Notably Easy to Operate!



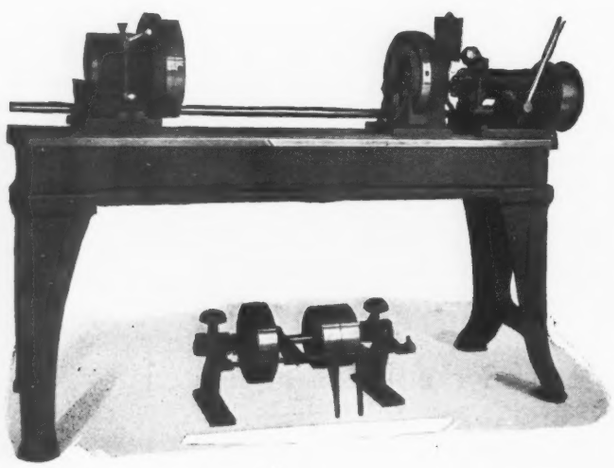
TURRET MILLHOLLAND LATHES

MILLHOLLAND MACHINE CO.

1102 West 23rd Street, Indianapolis, Ind.

New York Office: **2 Rector St., Room 433**

THE WHITON
Revolving Centering Machine



For Accurately Centering Finished Shafts

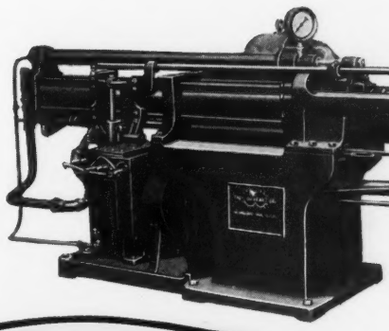
The cut shows new *Revolving Centering Machine* — a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machines and embodies all the special features.

Circulars and prices sent upon application.

THE D. E. WHITON MACHINE COMPANY

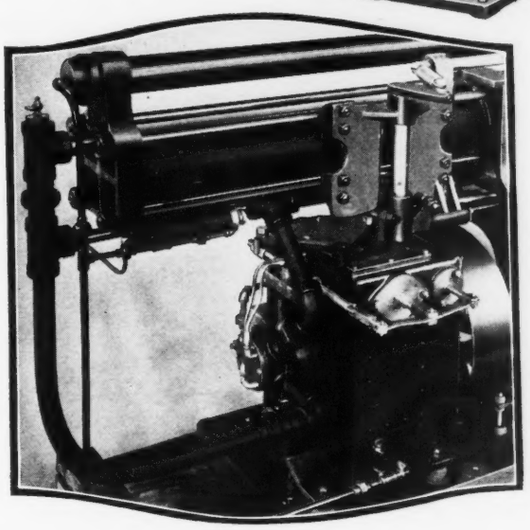
NEW LONDON, CONNECTICUT, U. S. A.



OILGEAR

REG. PAT. OFFICE

VARIABLE SPEED



Broaching vs. Reaming

Broaching round holes has heretofore never been considered feasible because of the excessive upkeep cost of the broaches. Reaming has been the only alternative. With the Oilgear High Speed Broaching Machine, manufacturers are now demonstrating to their complete satisfaction that broaching round holes is entirely practicable.

One manufacturer, a builder of a nationally advertised motor car, has been getting on his Oilgear Broaching Machine (in steel) an average of

3600 Draws Before Regrinding

as against 400 draws on screw-driven machines.

The success of the Oilgear High Speed Broaching Machine is due to the following facts:—

1—High cutting speed—30 feet per minute maximum.

2—Safety control prevents breakage of broaches (Oilgear control can be set to stop the machine when pull is excessive—no overrunning.)

3—Entire absence of mechanical shock to broaches.

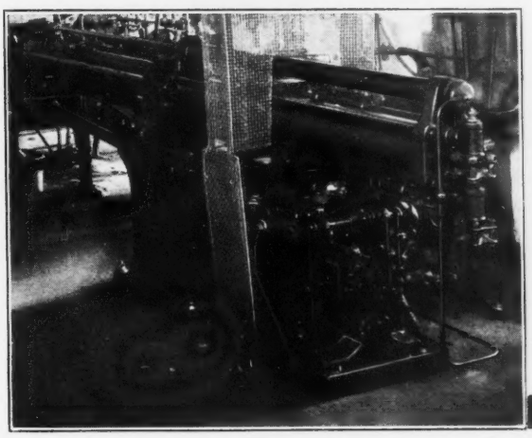
4—No twisting of broaches possible.

We'll be glad to demonstrate just what an Oilgear High Speed Broaching Machine will do on your work. Drop us a line if you are interested and we'll do the rest.

The Oilgear Pump

on the Oilgear High Speed Broaching Machine is fool-proof. It has no valves and no packing—nothing to get out of order. The only upkeep required for year-in and year-out service consists in checking the oil supply once every three months.

The illustration below shows an Oilgear High Speed Broaching Machine that is being used for broaching 5/8-inch round holes. The manufacturer finds that he gets a better job than he formerly obtained by reaming, that the broach cost is less than the reamer cost, and that the production is just as great.



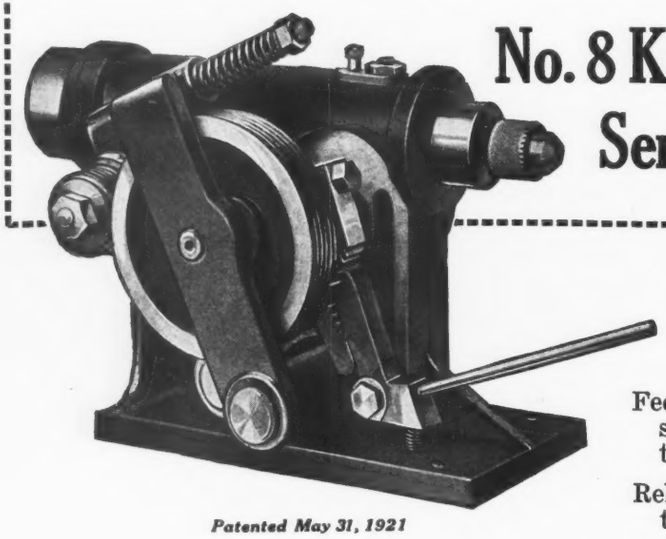
THE OILGEAR COMPANY

Manufacturers of Broaching Machines, Hydraulic Presses, Variable Delivery Pumps, and Variable Speed Drives.

64—27th Street, MILWAUKEE, WISCONSIN

BUFFALO: Buffalo Machinery Sales Corporation, 833 Ellicott Square. CHICAGO: Federal Machinery Sales Co., 12 N. Jefferson St. CLEVELAND: Cleveland Duplex Machinery Co., Inc., 1224 W. 6th St. DETROIT: Donald Clute, 428 East Jefferson Ave. INDIANAPOLIS: F. C. Litchfield, 1024 Hume-Mansur Bldg. PITTSBURGH: Laughlin-Barney Machinery Co., Union Trust Bldg. NEW YORK: Russell, Holbrook & Henderson, Inc., 30 Church St. ST. LOUIS: Elliott & Stephens Machinery Co., 721 Olive St.

No. 8 Kingsbury Automatic Sensitive Drill Head



Patented May 31, 1921

High Speed—
Uniform Pressure Feed
Automatic Spindle Control

Feed varied from .011" to 0 depending on resistance encountered by drill, consequently the machine operates at high efficiency.

Relieving cams can be furnished to duplicate the motions of a skilled operator, on difficult drilling jobs.

This drill head serves as a nucleous in the design of semi and full automatic universal and single purpose drilling machines that meet the demands of modern production.

We are prepared to furnish hopper feeds, indexing fixtures, for from 1 to 5 spindles, automatic clamping fixtures, etc. We also carry in stock various stands for vertical and horizontal mounting of the drill heads. Let us figure on suitable equipment for your work.

KINGSBURY MFG. COMPANY, Keene, New Hampshire

Represented by: Neff, Kohlbusch & Bissell, Inc., Chicago. Russell, Holbrook & Henderson, Inc., New York. Purinton & Smith, Hartford, Conn.

"Theoretically Correct" Drillpoints Automatically Produced on the Oliver Drillpointer



Patents allowed on form of Drillpoint and Machine for producing it.

They increase production by greatly increasing the number of holes per grind.

Drill close to size.

Double the life of your drills.

Reduce thrust nearly 50%, cutting down power bills and eliminating drill press repairs.

Save price of machine in short time.

Send us some drills to grind and let us prove it.

AN OLIVER OF ADRIAN PRODUCT

Oliver Instrument Company

1410 East Maumee Street
ADRIAN, MICHIGAN

New York Branch:
139 Lafayette St.,
Tel., Canal 3982

C. D. PROCTOR
District Sales Representative

SOCIETE GENEVOISE
Circular Dividing Machines
(Made in Switzerland)



Supplied in the following capacities and accuracies.

Cat. No.	Max. Diam. of Work Inches	Guaranteed Accuracy Seconds of Arc
0066	9⅜	±15 to 20
0067	22½	± 6
0082	26	± 6
0083	26	± 2
0062	38½	± 4
0064	38½	± 2
0064A	38½	± 1
0090	78	±15
0091	264	

Write for Prices

THE R. Y. FERNER COMPANY
U. S. Representatives
1410 H. St., N. W. Washington, D. C.

Bruno Slotting Attachment

$25.00

Converts Your Shaper into a $1000.00 Slotter

Standard Cutting Tools $1.50 Each



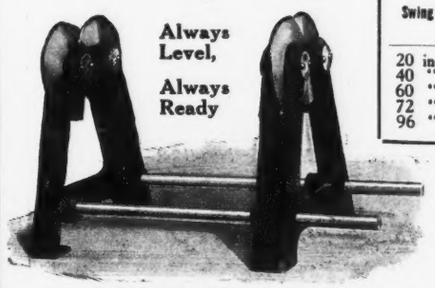
H. A. MOORE CO.

ROCHESTER N. Y., U. S. A.

ANDERSON Balancing Ways

Always Level,

Always Ready



They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

Ball bearing construction; chilled iron disks ground true and accurately balanced. Write for prices.

Manufactured by

ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD ILLINOIS

Snyder "G & A" Stud Driver

This tool drives the stud as tight as specifications require. The slightest back turn and the grip on the threads is released instantly. Made of high grade alloy steel, assuring service and durability. Either hand type, taper, square or hexagon shanks.

SNYDER MANUFACTURING COMPANY

850 Lafayette Blvd. W., DETROIT, MICH.

Buhr PATENT

Multiple Drill Heads

Increase the range and productivity of your single spindle drilling machines without increasing operating costs. 3 to 12 spindles. Write us for details.

NELSON-BLANCK MFG. CO., Detroit, Mich.

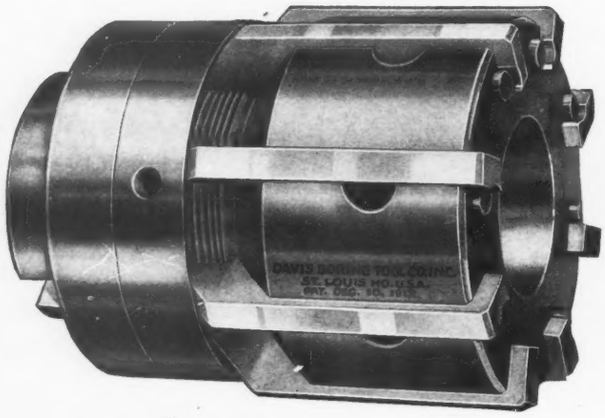
Chesterfield Cutting Metal is a new alloy of rare promise. It is non-corrosive, non-magnetic, extremely hard and retains its cutting edge when red hot—a cutting metal of unparalleled superiority.

Chesterfield Metal is a strictly metallic alloy—an ideal cutting metal for high speed work in cast iron and soft steel. It has hardness combined with toughness that enables it to hold the finest edge even under the most severe conditions.

Chesterfield Metal comes ready for use, cast to shape, which eliminates annealing and tempering; it merely requires grinding to be ready for the machine. It can be ground on either a dry or flooded wheel.

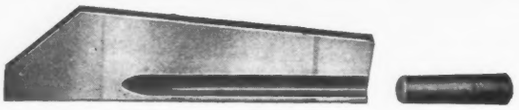
If you are interested in lowering cutting costs write for more information to the Chesterfield Metal Company, 261 St. Aubin Avenue, Detroit, Michigan.

WE SUPPLY THE WORLD WITH EXPANSION BORING TOOLS AND EXPANSION REAMERS



Davis Expansion Reamers

PATENTED 1912



This reamer is primarily intended for those plants where a moderate-priced tool is required to maintain a uniformly high production.

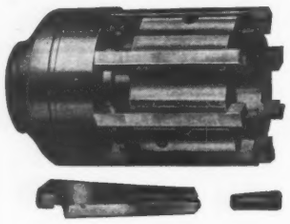
SHELL TYPE
GROUP II—No. 550

THE unlimited possibilities that Davis Expansion Reamers offer for increasing and improving production should interest those who endeavor to maintain maximum efficiency in their reaming production.

Davis Expansion Reamers rank supreme—they have no equal for efficiency, economy or production. They are designed on correct engineering principles that provide for greater range of expansion, full blade utility and quick, accurate adjustment. Their simple construction and ease of operation make them popular with the men who use them, and their low cost, economy and ability to produce, appeals to executives and owners who are anxious to obtain best results.

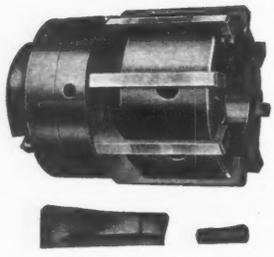
Expansion of blades is uniformly forward and outward on taper—thus eliminating circular grinding entirely when adjusting; while the ends of the blades always project and cut in advance of reamer body. Blades are held securely in reamer with hardened and ground taper pins that have 100 times the holding power of troublesome blade screws.

Do not experiment in your reaming production—adopt the Davis Reamer and be assured of best results at all times.



GROUP I—No. 540

A high class production reamer unequalled for maximum efficiency. Has graduated dial that controls blade movement, either forward or backward, within accurate limits of .00025 in.



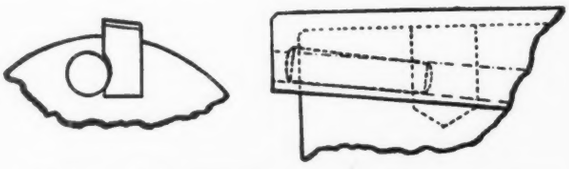
GROUP III—No. 560

A good, substantial, low-priced reamer designed for those shops where requirements are more or less limited.

Send for Descriptive Reamer Circular No. 522—Now

Davis Boring Tool Company
Incorporated
3706-22 Forest Park Boulevard
St. Louis, Missouri
Established 1903

Patented Method of Holding Blades



Blades are held in reamer with hardened and ground taper pins that are fitted, almost entirely, in reamer body at special angles that produce perfect line bearing in blade groove, for entire length of taper pin. The constant downward and lateral pressure along line of contact holds the blade rigidly, yet permits free movement of blades, backward or forward, in adjusting to required diameter.

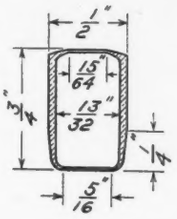
LARGEST EXCLUSIVE MANUFACTURERS OF EXPANSION BORING TOOLS AND EXPANSION REAMERS

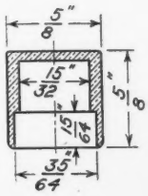
"Ledrite"

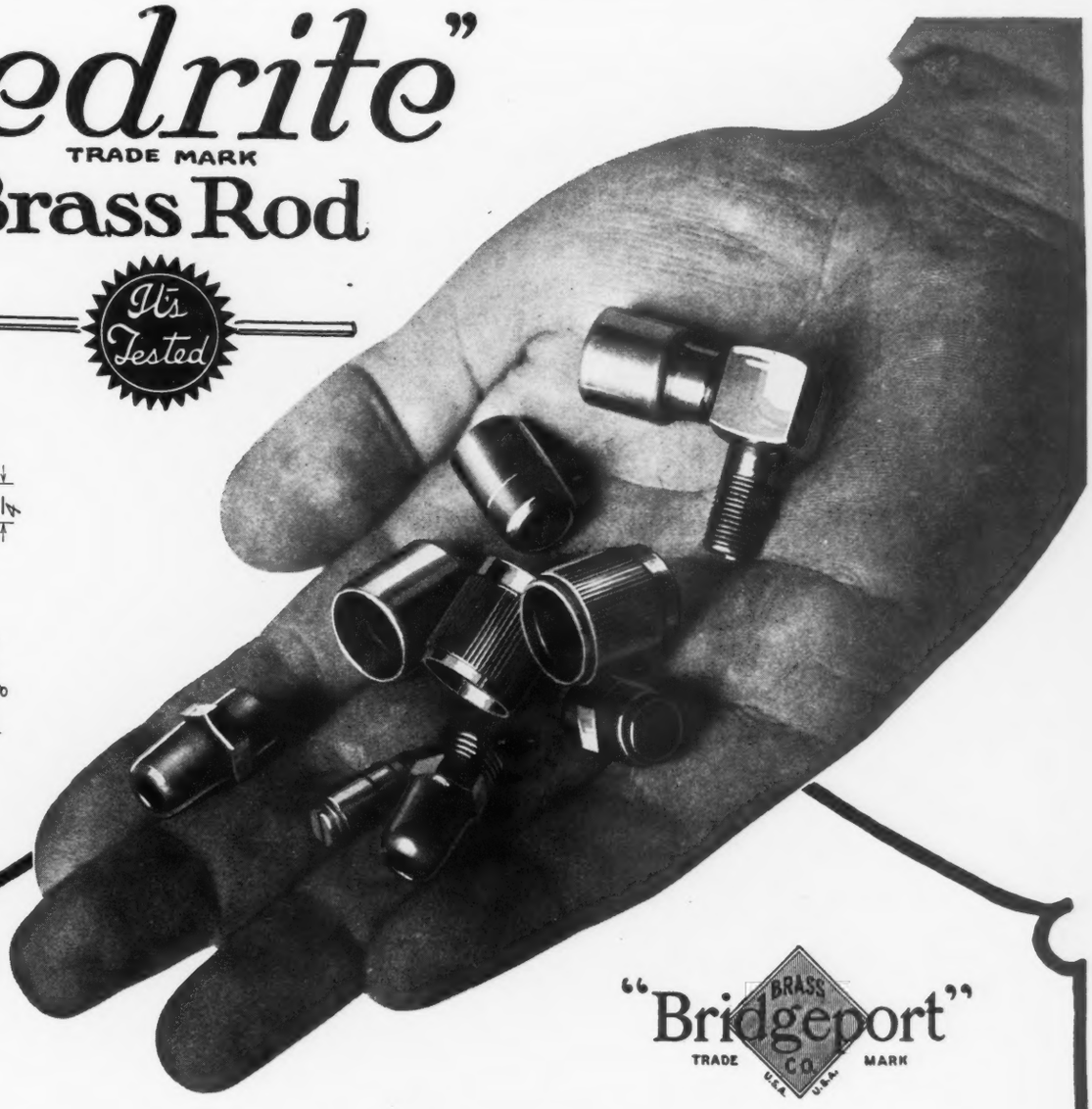
TRADE MARK

Brass Rod

It's Tested







"Bridgeport" TRADE BRASS CO. MARK U.S.A. U.S.A.

Mr. Oil Cup Manufacturer Is Perfectly Satisfied

He had not always been. For years he had bought Brass Rod but always there had been some source of trouble of one kind or another. Sometimes these troubles were of a very minor character, but annoying. Sometimes he paid a premium on his rod in slowed-up machines and greater percentage of rejections.

Then he heard of Ledrite and sent a trial order. He got free-cutting brass rod which did not heat up the tools; his automatics could be run at highest efficiency; work produced was accurate. Because the rod wasn't brittle second operations were equally fast and accurate. Ledrite Brass Rod was just what this manufacturer needed, what he *knew* he needed—and his troubles are over.

Ledrite is just what its name indicates—contains exactly the right quantity of lead—is uniform—is obtainable in any quantity.

Specify Ledrite on your next order. Send for our book on Brass Rod M823.

Pershing Square Building
NEW YORK
General Motors Building
DETROIT

Bridgeport Brass Company
Bridgeport Connecticut

North American Building
PHILADELPHIA
Wrigley Building
CHICAGO



Colton-Detroit Twist Drills



It's Safe to Drive Them Hard

Drive them hard—it brings out their superior qualities. Colton-Detroit Drills are high speed—in composition and performance. They finish more holes, require fewer grindings, and give longer service than most drills. Their wide grooves prevent clogging. They're more economical—and you can prove it.

Oversize shanks furnished without extra charge if you want them
Write for prices

ARTHUR COLTON COMPANY, Detroit, Mich.
2618 Jefferson Avenue, East

REPRESENTATIVES: **Buffalo:** W. V. Houck, 730 Marine Bank Bldg. **Chicago:** H. E. Barton Tool Co., 106 South Jefferson St. **Milwaukee:** General Sales Agency, 3205 Vine Street. **New York City:** F. A. Brady, Inc., 30 Church Street. **Pittsburgh:** W. E. Nagle & Son, Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Co., 745 No. Sixty-third Street. **San Francisco:** L. G. Henes, 75 Fremont Street. **Los Angeles:** L. G. Henes, 218 East Third St. **Cincinnati:** Advance Tool Co., Canal and Jackson Streets.



"HUNTER"

PNEUMATIC HAMMER
VANADIUM STEEL

RIVET SETS

—AND—

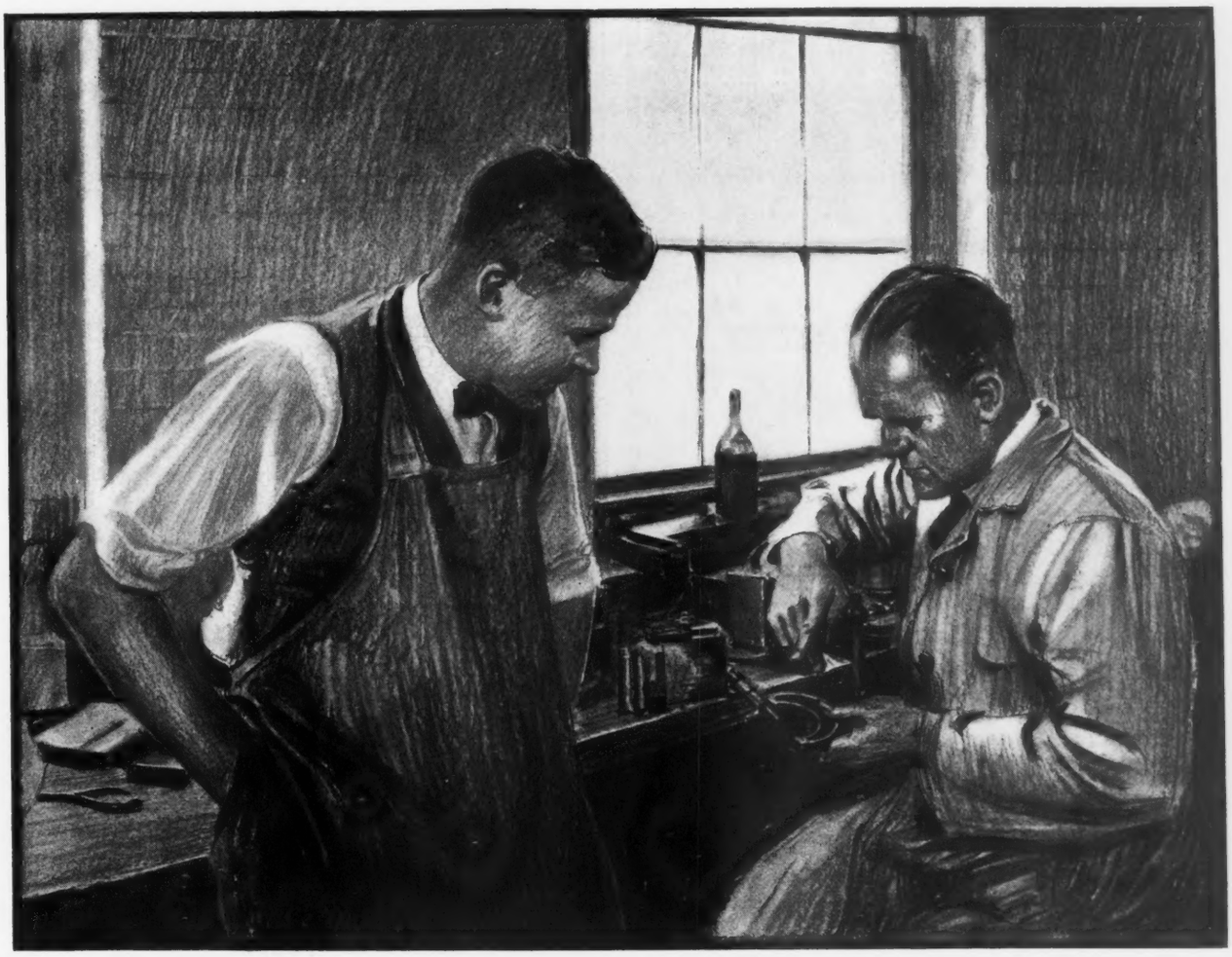
CHISEL BLANKS

The shanks of our Rivet Sets are faced to a slight radius. This insures the piston coming in contact in line with the axis of set, increasing the effect of piston stroke on rivets, a particular advantage when hammer cylinders are worn, with a marked reduction in shank breakage. Standard chisel blanks are made from ¾" x 9" or ⅞" x 8" octagon stock.

A full line carried in stock.

Hunter specialties include—Hot Saws, Friction Discs, Solid Blades made of Vanadium, Tungsten and Chrome Alloy Steel. Saw Sharpening Machines. Inserted Tooth Grinders. Hardened Steel Specialties. Catalog on request.

Hunter Saw & Machine Company
Pittsburgh, Pa.



"Eight years without adjustment"

"—and this Starrett 'mike' is just as accurate as the day I bought it eight years ago."

"Why shouldn't I be a Starrett booster?"

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.



Starrett Micrometer Calipers No. 226

Accurate gages at popular prices. Well adapted for general use as they can be set quickly for the different measurements and are easily read.

Graduated by thousandths, furnished with lock nut and supplied with or without ratchet stop as desired. Frames are drop forged from bar steel and nicely finished.

See page 172 of our Catalog No. 22D for description of No. 226 Sets. Write for copy if hardware dealer can't supply you.

STARRETT TOOLS

STARRETT HACK SAWS CUT QUICKER LAST LONGER

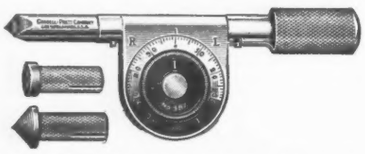
Use Starrett Micrometers

GOODELL-PRATT

1500 GOOD TOOLS

Speed Indicators

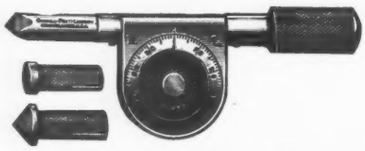
Let's look at the features that make Goodell-Pratt Speed Indicators the most desirable instruments of their kind.



No. 387 Double Dial registers to 1000 R.P.M. Price, each, $2.60.

We'll go right to the heart of the tool first and look at the gears that operate the dials. The driving gear is an accurately generated worm on the hardened steel spindle. This meshes with, and drives the hard brass gear to which the dial is attached.

The dials are plainly graduated in one direction only. This desirable improvement is made possible by the double end spindle and reversible handle.



No. 449 Double Dial registers to 100 R.P.M. Price, each, $2.20.

The cuts show the Indicators reading direct for a right hand shaft. To get the speed of a left hand shaft simply remove the handle and lock it into the other side of the neat die-cast frame.

In spite of these improvements the instrument is more compact, and the nicely knurled handle and bright nickel finish make it far pleasanter to handle.

Insist on getting Goodell-Pratt Speed Indicators.

Goodell-Pratt Company

Toolsmiths

GREENFIELD, MASS., U. S. A.

"Yes, Ford Talking— George Ford"

"You want to know how I used up those Taper Shank Drills with the tangs broken off?"

"Why, don't you know about the Wahlstrom Quick Change Chuck made for this very purpose? You change drills without stopping machine, and using up two or three drills with broken tangs pays for the chuck."

"Ask Wahlstrom to send you one on 10 days' trial. They'll do it."



Wahlstrom Tool Co.
5520 Second Avenue
BROOKLYN N. Y.

Your Tapping Costs



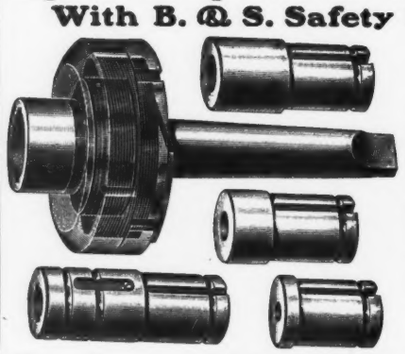
Largely depend upon the style of Tap Drive you use. **"WEAR-EVER" TAP CHUCKS** are distinctive for simplicity and effectiveness in reducing tap breakage and operation costs.

Why not apply this saving in your plant?

"Drives by the Square"
"Centers by the Shank"

SCULLY-JONES & CO.
Tool Division
15th and Robey Sts.
CHICAGO, ILL.

Speed Up Your Tapping
With B. & S. Safety Holder



You can drive taps at full speed to the bottoms of holes without fear of breakage. Tap driver stops instantly under excess torsion.

There's no lost motion—tool changes can be made without stopping spindle.

Five sizes. Taps to 2½" diameter.

Try one.

The Beaman & Smith Co., PROVIDENCE Rhode Island

"THE SIMPLEST DIE THAT OPENS"

The Only Die that Opens and Closes while Rotating

CUTS PARALLEL THREAD TO SHOULDER

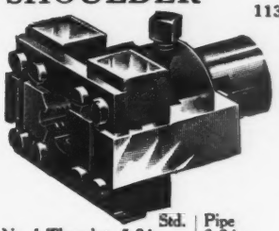


SKELETON FRAME
CHIP-PROOF AND FOOL-PROOF

The **Only Universally Automatic Die**; can be closed **While Rotating**; opens automatically either by Center-Stop, Shoulder-Stop, or Stop on Machine for any **Exact Length** of work.

Can be used on Drill Press, Speed Lathe, Engine Lathe, Turret Lathe.

SAVES TIME, CUTS COSTS, AND DOES BETTER WORK



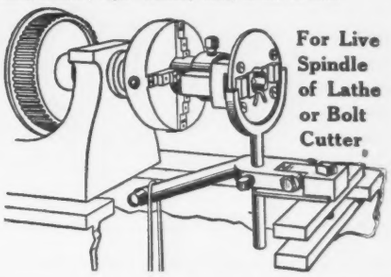
	Std.	Pipe
No. 1	Threads to 5-8 in.	3-8 in.
No. 2	" " 1 in.	3-4 in.
No. 3	" " 1 1-2 in.	1 in.
No. 4	" " 2 in.	1 1-2 n.
No. 5	" " 2½ in.	2 in.

ERRINGTON

Main Office: Broadway and John St., N. Y.
Phone Cortlandt 3149

Chicago Office: 113 N. Desplaines Street
Boston Office: 830 Old South Building

Catalog Francais; Edgar Bloxham, Paris, 12 Rue du Delta



For Live Spindle of Lathe or Bolt Cutter



The Chuck That Never Slips.

The More You Crowd It,

The Tighter It Grips.

NARRAGANSETT MACHINE CO.
PROVIDENCE, R. I., U. S. A.



For Multiple Drilling on Close Centers

Trump Drill Chucks are time and labor saving conveniences for multiple spindle machines. They drill holes up to ⅜" diameter and on centers down to ⅝".

Have only three parts, are hardened, finely finished and low in price. Can be used with all standard quick change drill chucks. Sizes No. 1, 0" to ⅛"; No. 2, 0" to ¼"; No. 3, 0" to ⅜".

Shipments made from stock.
Send for trial order.

Trump Brothers Machine Co.
Wilmington Delaware, U. S. A.

Almond PRODUCTS

Geared Drill Chucks
Standard Drill Chucks
Independent Lathe Chucks
Geared Scroll Lathe Chucks
Combination Lathe Chucks
Right Angle Transmission
Flexible Arms
Flexible Tubing
Micrometers
Fine Mechanical Tools

Illustrative Descriptive Bulletins Mailed upon Request

T. R. ALMOND MFG. CO., Ashburnham, Mass.

AMERICAN



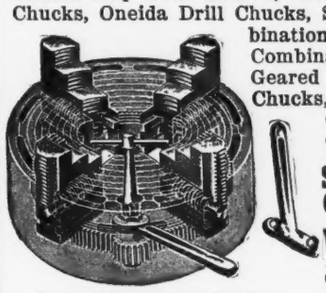
TAPS—DIES—SCREW PLATES—REAMERS

Let us quote on your next order.

American Tap & Die Co., Greenfield, Mass.

If you want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.

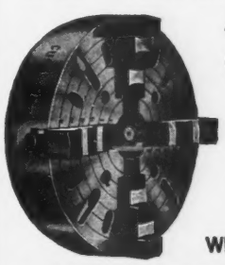


Spur Geared Scroll Combination Lathe Chuck

Strongest Grip, Greatest Capacity Great Durability and Accuracy

WESTCOTT CHUCK CO.
ONEIDA, N. Y., U. S. A.
Ask for Catalogue

CUSHMAN CHUCKS



4 Jaw Independent Type
"The Incomparable"
also
Self-Centering (Geared Scroll Type)
2 Jaw Lathe Chucks
"The Hartford" Drill Chucks

WRITE US FOR BOOKLET "The Incomparable"

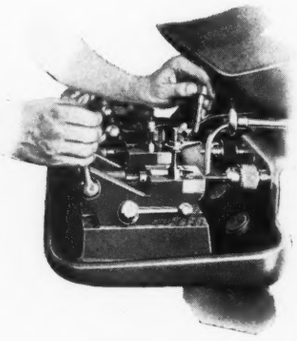
THE CUSHMAN CHUCK CO. HARTFORD, CONN., U.S.A.

DETROIT
Semi-Automatic Five Spindle Drilling Machines



A machine designed for the definite purpose of drilling small holes in small work as accurately and speedily as possible; a drill that takes a considerable range of work within certain limits and that fully meets the needs of modern manufacturing conditions.

The circular says, "The workmanship in the Detroit Semi-Automatic Drilling Machine is of the very best" and that includes, of course, the accessories with which it is equipped.



DETROIT MACHINE TOOL COMPANY — TIME FLIES — USE IT RIGHT — MORE PRODUCTION MACHINES

Detroit Semi-Automatic Five Spindle Drilling Machines are Regularly Equipped with

Jacobs Chucks

Good Mechanics Work Better With Good Tools

This advertisement is published in the interests of good Drilling Equipment by the makers of the Jacobs Chuck

WALKER MAGNETIC CHUCKS



Fine Finishing on a Production Basis

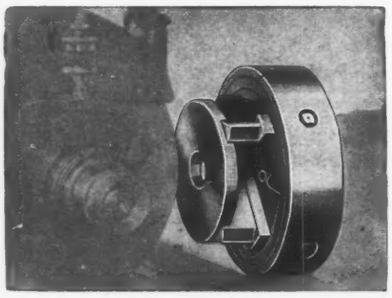
The limits are so close on these mold blades for type casting machines, that the work is inspected on a comparator measuring to ten thousandths (no perceptible variation is passed) and the corners are inspected for sharpness with a magnifying glass. That the work is on a profitable production basis in spite of this is due to the Walker Magnetic Chuck; the parts are loaded 14 at a time and .0035″ of metal is removed in seven grinds.

How else would you hold such parts without strain or distortion; how else could you chuck them *quickly* and *easily* as well as accurately?

Old users say, "Walker Magnetic Chucks are the best way to chuck most work, the *only* way to chuck some of it." Let us tell you all about them.

O. S. WALKER CO., Inc., Worcester, Mass., U.S.A.

GRINDING MACHINE CHUCKS



This type of chuck was designed and perfected for use on grinding machines. The slots in the face are less exposed than usual; hence, the operating screws that move the jaws are well protected from emery dust.

The patented two-piece reversible jaws can easily be reversed without removing the jaw body. Strong, dependable, accurate.

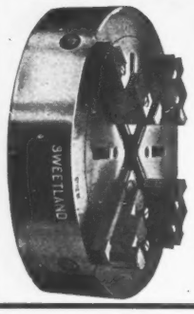
Illustrated literature and catalogue upon request.

THE SKINNER CHUCK COMPANY

NEW BRITIAN, CONN. U. S. A.
ESTABLISHED 1867

New York Office: 94 Reade St. | Chicago Office: 552 West Washington Blvd. | Cincinnati Office: 915 Broadway
San Francisco Office: Rialto Bldg. | London Office: 139 Queen Victoria St., E. C. 4

SWEETLAND CHUCKS



If Limited to One Chuck—

Style No. 40 would serve your needs, 4-Jaw combination: hardened steel jaws, interchangeable and reversible; easy to operate; sizes 6" to 24" in 3" steps; to 42" in 6" steps.

Catalog 13-C tells about it. Write for a copy.

THE HOGGSON & PETTIS MFG. CO.
New Haven Connecticut, U. S. A.

"LOGAN"

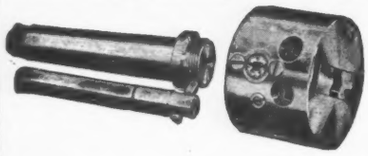
Air-Operated Chucks and Labor-Saving Devices



Increase Operating Efficiency, and Production Capacity. "LOGAN" Complete Equipment to meet every Chucking or Holding requirement. Try one for thirty days at our expense. Send for Catalog R-15.

THE LOGANSPORT MACHINE CO.
529 Market Street Logansport, Indiana, U. S. A.

For Economy in Precision Boring



Flynn Micrometer Off-Set Boring Heads

Think of the convenience and the time you can save on jig, fixture and experimental work by having a boring tool so fixed that you can advance it by thousandths, plainly indicated on an easily read dial, with the same wrench which turns the screws which open and lock the jaws.

Heads run concentric with minimum overhang and no projections to interfere in close quarters.

Let us tell you more about it.

J. M. WATERSTON, 425 Woodward Ave. DETROIT, MICH.

Lavoie Air Chucks

See them in operation; note the small number of parts, the simplicity of operation. No objectionable cylinder at rear of spindle; only a single line of piping required.

The Frontier Chuck and Tool Co., Inc.
30 Letchworth St. BUFFALO, N. Y.

TITAN QUICK CHANGE DRILL CHUCKS AND COLLETS

TITAN TOOL CO. Erie, Pa., U. S. A.

Detroit, Mich.: E. H. Welker Company, 222 West Larned Street. Chicago, Ill.: Rickert-Shafer Co., 117 N. Jefferson St. Cincinnati, Ohio: C. M. Bigger & Co., 414 Elm St. Cleveland, Ohio: Rickert-Shafer Co., 380 Rockefeller Bldg. Indianapolis, Ind.: Indiana Tool Service Co., 321 Occidental Bldg. New York: Rickert-Shafer Co., 50 Church St. Boston: Rickert-Shafer Co., 755 Boylston St. Philadelphia: Normoyle & Lapp, 514 Liberty Bldg.



Made in Three Sizes—½", ¾" and 1" capacity.

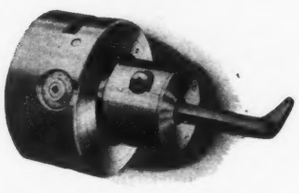
CASLER TOOLS

The surest way to determine exactly how much time and trouble Casler Twin Screw Drill Chucks and Off-Set Boring Heads will save in your plant and to what extent they will improve your output is to try them—preferably on your most expensive jobs.

Write for details and 30 days' free trial offer.

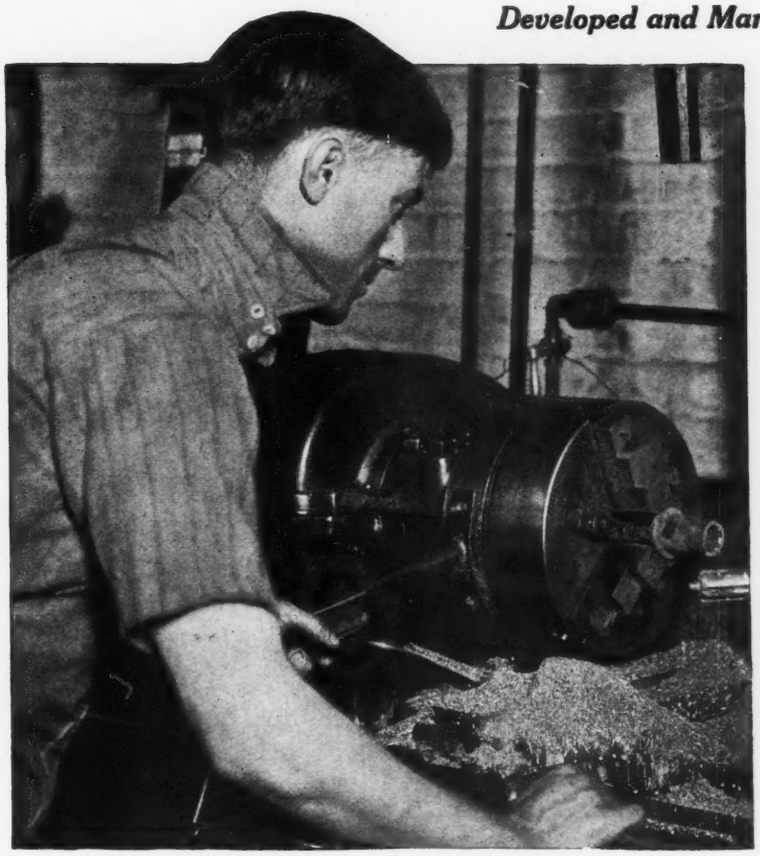
Production Engineering Corporation
CANASTOTA NEW YORK

The CASLER Off-Set Adjustable Boring Head.



Micrometer Adjustment to thousandths. Five sizes—½" to 1½" capacity—3/16" to ⅝" offset.

Developed and Manufactured by Thomas Elevator Co.



BARKER WRENCHLESS CHUCK

Turn Unproductive Minutes into Productive Hours—

Your machine tools—turret lathes, automatics, semi-automatics.

Only when they are *busy* do you make money. But when they stand idle—you lose.

Every machine loses a certain percentage of the day in adjustments of some kind or other. And if you could *reduce* that lost percentage—if you could gather up those minutes wasted in adjusting (chucking and changing the work), mold it into hours, then use it as *productive time*—it is not possible to reckon the days, the *weeks* you would save.

The Barker Wrenchless Chuck offers you a solution to this problem.

THOMAS ELEVATOR CO.
24 South Hoyne Ave. CHICAGO

HANNIFIN
Production Tools—

Air Operated Chucks—Adjustable Boring Bars

Air operated Arbor Presses, Chucks, etc.; Countershafts, Vises, Mandrels and Clamping Devices, Adjustable Boring Tools, Multiple Boring and Reaming Tools, Adjustable Reamers, Line Boring and Reaming Bars, and Cylinder Boring and Reaming Tools, Car Wheel Boring Bars.

Catalogues on Request.

Hannifin Manufacturing Co.
Lexington and Kolmar Aves. Chicago

Horton



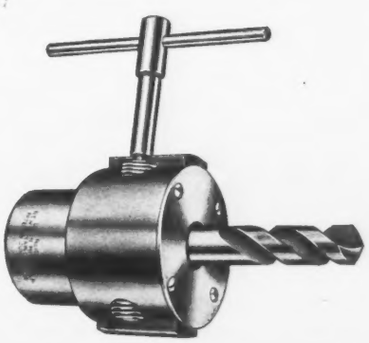
Two-Jaw Drill Chucks

Simple—compact, two jaws, single screw, solid body. Made for hard work and severe use. Seven sizes from 0-1/4″ to 0-2″.

The E. Horton & Son Co., Windsor Locks, Conn., U. S. A.

Begin with Practical Chucks

Union Chucks are designed to economize time and are made in sizes and styles to meet every requirement. Every chuck fully guaranteed. A feature of this Positive Friction Drill Chuck is the Transverse Slot which provides for using drills with tenons. Seven sizes—0 to 2″.



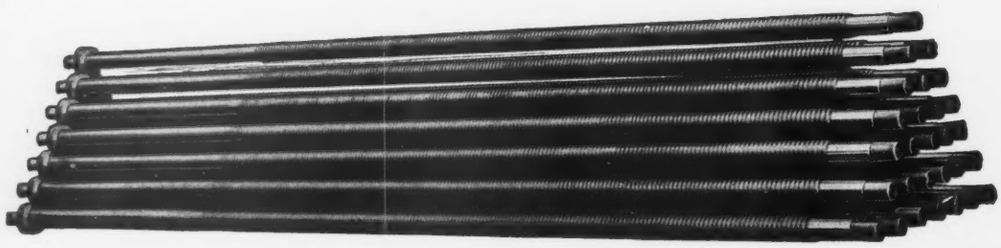
Complete line described in catalog which we will be glad to send on request

Union Manufacturing Company
New York Office
26 Cortlandt Street **New Britain, Conn., U. S. A.**

Makers of a Complete Line of Chucks

Hindley Screws

To use them once is to become a Hindley customer. Hindley Screws are accurate; possess unusual strength and wearing qualities. They're guaranteed. Lead, Feed and Power.



Let us quote.

HINDLEY GEAR COMPANY
1105 Frankford Ave.
PHILADELPHIA, PA.

WHEREVER NUTS ARE TURNED TIME CAN BE SAVED BY USING THE

FAVORITE
REVERSIBLE RATCHET
WRENCH



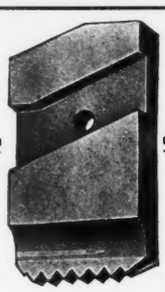
The FAVORITE wrench does not have to be removed from the nut at every quarter turn, as required with open end wrenches, but stays on the nut until operation is completed.
Its ratchet movement is quick, straight forward and positive.

BUILT STRONG FOR ROUGH USAGE

Write us for full particulars

Greene, Tweed & Co.
Sole Manufacturers
109 Duane St.
New York
Tool Department





Why H & G Die-heads Always Produce

1. Chasers are hobbed. Hobbed chasers fit the screw as a nut fits the lead screw. This is the only correct method by which accurate results can be secured.
2. H & G chasers are hobbed with Hanson Hobs. Hanson Hobs are finished after hardening, accurate in lead and thread form and perfect in finish—all of which is reproduced in the threads cut by H & G chasers.
3. The chasers are supported in the die-head by cams directly over the cutting point and cannot give under the strain of cutting.
4. The entire body and all parts of H & G Die-heads are hardened and accurately ground. Chaser slots are tested with go and no-go gauges having less than one-thousandth difference.

New 96-page Catalog

This new miniature catalog contains much valuable information relative to thread cutting in addition to a complete description of H & G Die-heads which are adaptable to all machines.

The Eastern Machine Screw Corporation
23-43 Barclay Street, New Haven, Conn.
Die-heads that Revolutionize Threading

H&G

VULCANIZED FIBRE

BE SURE AND SPECIFY "WILMINGTON FIBRE"
SHEETS RODS TUBES WASHERS, &c. SPECIALTIES

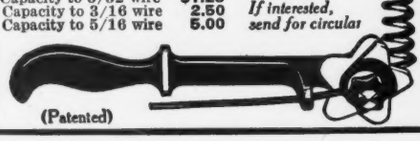
WILMINGTON FIBRE SPECIALTY CO., Wilmington, Del.
BRANCH OFFICES "EVERYWHERE"

Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left-hand.

Capacity to 3/32 wire	$1.25
Capacity to 3/16 wire	2.50
Capacity to 5/16 wire	5.00

If interested, send for circular



(Patented)

Hjorth Lathe & Tool Company
10 Tremont St., Boston, Mass.
Works: Woburn, Mass.

STEEL In stock at **Lupton** warehouse **SHELVING**
INVESTMENT VALUE PHILADELPHIA
David Lupton's Sons Co., Phila.

When you need a special machine or special tools—want unusual forgings—a line on stampings—expert advice on special machinery of any kind—consult MACHINERY'S Special Equipment Section.



THE GREEN SECTION

GRINDERS

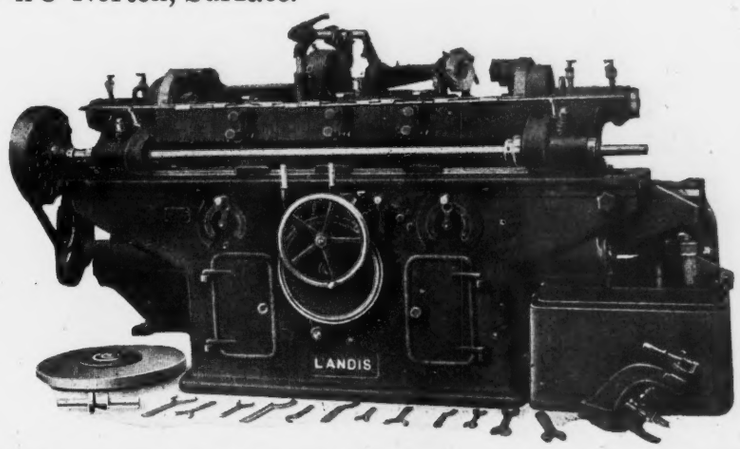
CURRENT MODELS—ATTRACTIVE PRICES

NORTON

6— 6″ x 32″ Norton, Plain.
12—10″ x 36″ Norton, Plain.
3—10″ x 72″ Norton, Plain.
1—14″ x 36″ Norton, Plain.
13—14″ x 50″ Norton, Plain.
5—14″ x 72″ Norton, Plain.
1—16″ x 72″ Norton, Plain.
1—15″ x 8′ Norton, Surface.

LANDIS

1—No. 1, 10″ x 20″ Landis, Univ.
5—12″ x 36″ Landis, Plain.
2—No. 3, 12″ x 36″ Landis, Univ.
1—12″ x 96″ Landis, Plain.
7—16″ x 48″ Landis, Crankshaft.
1—20″ x 96″ Landis, Plain.
1—20″ x 168″ Landis, Plain.



16" x 48" LANDIS SELF-CONTAINED CRANKSHAFT GRINDERS $1750

also

14" x 50" NORTON PLAIN $1650
14" x 50" NORTON CRANKSHAFT $1750

MISCELLANEOUS

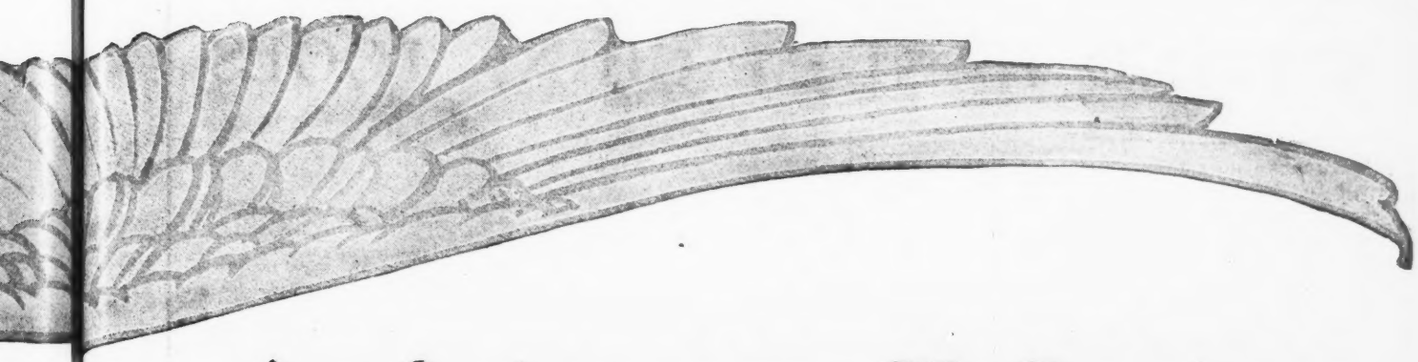
1—No. 4 Gardner disc. B.B.
1—No. 6 Gardner disc. B.B.
1—No. 16 Besly Disc.
1—Modern Internal.
1—No. 10A, Bryant Internal.
2—No. 20 Bryant Internal.
1—No. 75 Heald Internal.
2—No. 22 Pratt & Whitney Vertical.
2—No. 1, 5″ x 20″ Morse, Plain.
2—No. 1, 5″ x 18″ Ott, Plain.
2—No. 2, 10″ x 30″ Fraser, Univ.
1—No. 2, 10″ x 30″ Webster & Perks
1—6″ x 20″ Fitchburg, Plain.
3—12″ x 36″ Modern, Plain.
5—12″ x 36″ Fitchburg, Plain.
1—14″ x 48″ Queen City, Plain.
1—84″ Diamond Face Guide Bar.

OUR GUARANTEE: your money back if you return machine in 30 days, freight prepaid. No excuses necessary.

HILL, CLARKE & CO. of CHICAGO

649 W. WASHINGTON BLVD.


WAR DEPARTMENT
U.S.
CATALOG
Q.M.
SALES
Rehber 1918



As a business man—War Department sales compel your investigation

There are two sides to the Surplus Property situation:

1—The taxpayer's side of the billions of dollars in what financiers call "frozen assets."

2—The business man's (taxpayer too) side of tremendous stocks, which, if suddenly dumped on the market would cause violent price reactions.

At the beginning of 1919 the War Department faced the job of reconciling these two problems. Everyone appreciated the almost Herculean task.

Everybody was interested.

Not without mistakes but with a definiteness that accomplished the disposal of billions of dollars worth of materials at a remarkably low cost, the work of the Director of Sales Office was started.

Then a strange, but very human thing happened.

Because no load was laid on the shoulders of business, a great number of business men have never investigated the Surplus Property sales.

And this indifference has robbed many business men of the opportunity for profitably sharing in this great plan of distribution.

But it is not too late to come in—to investigate what the War Department still has to offer.

Final sales are being planned.

As taxpayers and for their own financial gain, American business men are urged to investigate the sales which are being announced—to appoint personal representatives to inspect the stocks—to carefully appraise the offerings.

You will find your Government a willing co-operator to clarify any details and assist with your investigation.

The Way to Investigate

Watch your Commercial Business Publication and the Metropolitan Dailies for announcements of specific auction or sealed bid sales.

Send for the Catalog mentioned in the announcement. Check off the items that interest you.

Send a representative to the sale to inspect the materials—in advance, *if possible.*

To ensure you more leeway, send your name and address at once to Major J. L. Frink, Chief, Sales Promotion Section, Room 2515, Munitions Building, Washington, D. C. Advise him the character of materials you are interested in, and catalogs containing such materials will be forwarded you as rapidly as sales are scheduled.



Final commodity sales will begin in September and continue until liquidation of stocks is completed at the Quartermaster Depots in Brooklyn, Chicago, San Antonio and San Francisco. Offerings include a wide range of Quartermaster Supplies, Ordnance Property and smaller quantities of Engineer Property, Chemical Warfare and Medical and Hospital Supplies.

Important sales of Real Estate, Buildings, Plants and Warehouses will be held at Camp Devens, Ayer, Mass.; Camp Dix, N. J.; Ordnance Reserve Depot, Amatol, N. J.; Camp Meade, Md.; Ordnance Reserve Depot, Toledo, O.; Camp Knox, Louisville, Ky., and Camp Lewis, American Lake, Wash. Definite dates will be announced later.

Look for the Eagle before you shop.

WAR DEPARTMENT

SECOND-HAND MACHINE TOOLS

Drills

1 spdl. Avey & Henry & Wright, ball bearing
2 spdl. Avey & Henry & Wright ball bearing
3 spdl. Avey & Allen, ball bearing
4 spdl. Avey & Allen, ball bearing
4 spdl. Avey, ball bearing, power feed
20", 25", 28", 30", 32", 36" uprights
3, 4, 5 ft. radials
D-2 Colburn mfg. drill
No. 315 Baker mfg. drill
No. 513 Baker heavy mfg. type
8 spdl. Fox multiple spindle

Lathes

9"x20" Porter Cable mfg. type
14"x6' Lodge & Shipley, C.R., P.C.F., Q.C.
14"x6' Hendey, C.R., P.C.F., Q.C.
16"x8' Champion, C.R., P.C.F., Q.C.
16"x8' LeBlond, C.R., P.C.F., Q.C.
18"x8' Lodge & Shipley, C.R., P.C.F., Q.C., geared hd.
20"x8' American, C.R., P.C.F., Q.C.
24"x12' LeBlond, C.R., P.C.F., Q.C.
24"x22' Lodge & Shipley, C.R., P.C.F., Q.C.
38"x20' New Haven, C.R., P.C.F., Q.C.
14—28"x8' Fay & Scott, extension bed gap lathe
24 46" x 10' Fay & Scott, extension bed gap lathe

Boring Mills

No. 1 Lucas table type horizontal, 3" bar
Bement-Niles R & L table type horizontal, 3⅞" bar
34" Colburn, vertical type, turret head
24" and 36" Bullard, New Era type turret head
38" and 51" Niles, 2 heads on rail
42" and 48" Colburn, 2 heads on rail
84" Betts

Screw Machines and Turret Lathes

No. 0 B. & S. Automatic
⅜", ½", ⅝", ⅞" Cleveland automatic plain, Model B
½", ⅝", ⅞", 1¼" Cleveland automatic turret, Model A
4—¼" Gridley automatic, arranged for M.D., with motor
1", 1¼", 1½" Cincinnati-Acme with wire feed
⅝", 1", 1½" Pratt & Whitney, with wire feed
2¼", and 3¼" Jones & Lamson, flat turret type with both bar and chucking equipment
2¼" and 3¼" Cincinnati-Acme, flat turret type with both bar and chucking equipment
No. 1B Foster, turret type
16 W & S Fox turret type, with chasing bar
16 and 18" Cincinnati-Acme, turret type, with chasing bar

Grinders

12" x 36" Cincinnati universal
3", 6", 10" swing x 18", 32", 36", 72" long Norton, plain
10" and 12" and 30" and 120" Landis, plain
No. 2 Reed, surface type
12" x 36" Diamond, surface type
14" Pratt & Whitney vertical surface type
10" Garrigus, rotary surface type
Nos. 1 and 1½ Cincinnati cutter and tool
No. 2 Walker cutter and Tool
Nos. 1 and 2 Norton cutter and tool
No. 2 Oakley cutter and tool
No. 60 Heald cylinder
No. 70 Heald internal
Taylor high speed water tool

Millers

Nos. 2, 3, 4 Cincinnati, plain
Nos. 2, 3, Brown & Sharpe, plain
No. 25 Becker-Brainerd, plain
Nos. 2, 3, Cincinnati, universal
No. 2 Hendey, universal
No. 2 Brown & Sharpe, universal
Nos. 2, 3, 4 Cincinnati, vertical
No. 4B, No. 5, No. 5B Becker-Brainerd, vertical
No. 2C Becker-Brainerd, vertical
No. ½ Van Norman, duplex type
No. 4 ½ x 12 Pratt & Whitney, thread type
30" x 10' Ingersoll, slab type

Shapers and Planers

14", 16", 20", 24" Gould & Eberhardt, B.G. crank shapers
16", 20", 24" Hendey friction shapers
15" Potter & Johnston tool-room crank shapers
16" Smith & Mills, back geared crank shapers
15" Kelley crank shaper
24" x 24" x 6' Flather Planer, 1 hd.
30" x 30" x 8' Gray type Planer, 2 hds.
36" x 36" x 12' Pond Planer, 2 hds.
50" x 40" x 14' Pond Planer, 2 hds.
66" x 54" x 12' Pond Planer, 2 hds.
66" x 60" x 30' Bement Planer, 3 hds.
96" x 60" x 12' Detrick & Harvey open side, convertible type plain, 4 heads, reversible motor drive with motors.

Miscellaneous

Nos. 1, 3, 4 Lapointe broaching machines
36" Gould & Eberhardt automatic gear cutters
6" Gleason bevel gear cutter
V & O Bliss & Ferracute power presses

HENRY PRENTISS & COMPANY

149 Broadway, New York.

BOSTON BUFFALO HARTFORD SYRACUSE ROCHESTER

BORING MILLS

No. 1 Cleveland Horiz. (new)
No. 2 Rockford Horiz. (new)
60" Betts Horiz., 4" bar
52" Bertram Horiz., 2⅝" bar
52" Bausch Vert., 2 rail hds.
60" Bullard Vert., 2 heads

HAMMERS

500 lb. Billings & Spencer Board Drop
800 lb. Massillon Steam Drop
1100 lb. Erie Steam Forging
1200 lb. Bliss Board Drop

KEYSEATERS

No. 0, No. 3 and No. 3-A Mitts & Merrill Giant
No. 0 Baker, cap. 1" keyseats
John T. Burr Keyseat Miller, 60" feed

MILLERS

No. 4 Hendey Lincoln Type
No. 32 Kempsmith Lincoln
No. 25 Becker Plain
No. 2 Cleveland Plain
No. 4-B, No. 5-B and No. 6-B Becker Vertical
No. 8 Lees-Bradner Thread
42" x 40" x 8' Ingersoll Slab, incl. 14 cutters

TURRET LATHES

18" and 26" Libby
¾", 1¼" and 2" Wood Tilted Turret (new)
21" Gisholt
24" Steinle

MISCELLANEOUS

Used leather belting; chain hoists; gear cutters.

THE E. L. ESSLEY MACHINERY CO.

Main Store
551 W. Washington Blvd., Chicago

Branch Store
78 W. Water St., Milwaukee

Priced Right for Present Conditions

A FEW OF OUR BARGAINS IN USED MACHINERY

1—Bradford 18 x 18' Standard Engine Lathe. SBG. CR.
1—16 x 8' Reed-Prentice Engine Lathe.
1—⅞" Cleveland Automatic Screw Machine.
1—2" Cleveland Automatic Screw Machine.
1—Hurlbut-Rogers 5" Double Cut-off Machine.
1—No. 2 Barber Coleman Gear Hobber, very fine.
1—Bridgeport 36" x 24' Extra Heavy Geared Head Engine Lathe, motor driven.
3—No. 4 Warner & Swasey Geared Friction Head Turret Lathes.
1—No. 0, B & S Plain Milling Machine.
1—No. 1 B & S Plain Milling Machine.
1—Porter-Cable 9" x 20" Production Lathe.
1—American Tool & Machine Co.'s No. 1 Square Arbor Brass Worker's Lathe.
1—No. 12 Leland Profileing Machine, with pump.
1—No. 35 Giddings & Lewis Horizontal Boring Machine.
1—Cincinnati Electric Grinder, 120 Volt D. C.
1—Brown & Sharpe No. 29 Plain Cylindrical Grinder, capacity 18" x 10' between centers.
1—Gardner No. 4 Ball-bearing Disc Grinding Machine, with right-hand plain table.
1—6" Oster Pipe Machine and equipment.
1—3/16" A.D.T. Shuster Riveting Machine.
1—Brunner Automatic Air Compressor with ½ H.P. 110 V., single phase A.C. motor.

The E. A. Kinsey Co., Cincinnati, Ohio. Indianapolis, Ind. Hamilton, Ohio

Why Waste Time at Auction Sales?

Our prices are lower, and we sell Machinery under a Real Guarantee

MILLING MACHINES—New and Used

3—No. 1½ Rockford Univ., cone type, cap. 25x77½x18.
2—No. 2½ Rockford Univ., cone type, cap. 34x9x18.
1—No. 2½ Rockford Univ., high pwr., grd., sgle. pulley drive, cap. 24x8x18.
2—No. 1½ American Pl. and Univ., cone type, cap. 25x19x19.
1—No. 2 Becker Plain, M.D.
6—No. 32 Kempsmith Lincoln
1—Nos. 1 and 2 Newton Keyseat Mills, M.D.
1—Ingersoll Slab 20x20x8'.
3—No. 3½ Fox, Table 7x27½".
1—No. 0 Bickett Vert. Mill and Profiler.

MISCELLANEOUS

1—27"x12' Greaves-Klusman Lathe—D.B.G., Q.C.
3—16"x8' Sidney Lathes, Q.C.
1—50" Sellers Car Wheel Borer.
1—52" Bertsch Multiple Punch.
1—20" Hendey Shaper.
2—10x36" Thompson Univ. Grs.
12—Gisholt 24" Turret Lathes.
4—Multi. Drills 3 to 24 spds.
14—Screw Mchs. 2 to 3¼" cap.
5—Oakley Univ. Grinders 10x20.
1—10x24" Landis Pl. Grinder.
1—No. 20 Lea Simplex Cold Metal Saw arranged M.D.
1—Amer. Radial Drill 3', T.A.
1—Amer. Radial Drill, 3½', T.A.
1—26" Barnes All Geared Head Drill Press, high power.
1—22" Barnes Heavy Duty Drill.
1—Hanna Riveter, 66" reach, 15" gap, 20 Ton cap.; approx. 5/16" cold, 9/16" hot rivets.
1—Ohio Shaper, 16/20".
1—Whipp Shaper, 20" B.G.
1—42x36x8 Am. Planer; 2 hds.
1—Pond Planer, 80" bet. housings, 49" under rail, 12' bed, 4 heads, motor drive.
1—42x36x18' Rockford Planer; 2 heads; arranged M.D.
1—96" Niagara Squaring Shear; 18 gauge cap.
1—No. 9-A Badger Double End Punch and Shear, 12" Throat, cap. punch ½ through ½" plate.

Money back if not satisfied.
Over 1,000 Machines in stock.

WAYNE MACHINERY CO.

Ft. Wayne, Ind.

14-Inch Lathes
Plenty to Pick From

FLATHER PRATT & WHITNEY ROCKFORD
HENDEY SENECA FALLS SEBASTIAN
AMERICAN CARROLL-JAMIESON LEBLOND
WHITCOMB-BLAISDELL

Prices range from $125.00 to $600.00

Our Blue List No. 7 gives complete details.

HILL, CLARKE & COMPANY, Inc.

156 Oliver Street *The Machinery Merchants* Boston 9, Mass.

THE
OSBORNE & SEXTON
MACHINERY COMPANY
COLUMBUS OHIO

Band Saw, metal Klemem, 12"
Bending Rolls, 7 for ¾" plate
Boring Mill, vertical, 12", 2 heads
Boring Mill, Colburn, 48", 54" and 60", 2 heads
Brake, 8' 22 Gauge, hand operated
Chucking Machine, No. 23, New Britain.
Compressors, 6 x 6, 9 x 8 and 12 x 10
Drills, Barnes 26" all geared (2)
Drills, Sliding Head, 24, 26, 28 and 32"
Gear Millers, Automatic, Bilton No. 1 (5)
Grinders, Surface, 1, 3 and 78 Wilmarth & Morman
Grinders, 10 x 24 and 6 x 32 Norton Plain
Grinder, B. & S. No. 24 Dbl. Spdl., Internal
Grinder, Universal, 10 x 30 W. & P.
Grinder, Universal, 12 x 36 Cincinnati
Grinder, No. 4 Gardner double disc.
Hammer, 40 lb. Bradley Cushioned Helve
Lathes, 14" x 6' and 18" x 8' Monarch
Lathe, 24" x 24' Prentice with raising block
Lathe, 25" x 14', Schummacher-Boye
Milling Machine No. 2 heavy Brown & Sharpe Pl.
Milling Machine, No. 25 Becker, Plain
Milling Mch. No. 32, Kempsmith, Lincoln Type (3)
Milling and Drilling Machine, No. 1 Knight
Planer, 24 x 24 x 6' Pease, Single Head
Planer, 36" x 36" x 12' Niles, Parallel drive
Planer, 48" x 48" x 16' Bement-Niles, 2 head
Planer, 60" x 60" x 17' Betts
Presses, 1, 1500 lbs.; 2½, 3000 lbs. Robinson.
Punch and Shear, ½ x ½—10" throat
Pipe Machines, 2", 4", 6" and 12".
Pyrometer, Brown 2000 degrees for furnaces
Radials, 3' Morris plain, gear box
Screw Machines, National Acme, Nos. 52 and 56
Scleroscope, Shore, Style B, complete (3)
Shapers, 14" Niles, traveling head
Shapers, 14", 16" and 21" Smith & Mills
Shear, No. 20 Quickwork, 14 gauge—30" throat
Shear, 5' Robinson, 10 gauge
Turret Lathe, 1" and 1¼" Millholland
Turret Lathe, 1½" Friction Back Geared, Wood
Turrets, 2x24 and 3x36 J & L Single Pulley
Turret Lathe, No. 6, Warner & Swasey, prac. new.

NEW 3 PHASE MOTORS 5 H.P., $67.50, 3 H.P., $57.50

FOR SALE
Property of the Jamestown Die & Tool Corporation located in Jamestown, N. Y.

Consisting of land, building, stock and equipment. 1 acre of land; thoroughly modern concrete steel building, 185 feet by 83 feet, equipped with heating and lighting; the following machines all in excellent condition, as good as new and have been used on nothing but the highest grade of tool and die work:

LATHES
1 Hendey Norton, 20" x 8'
1 Blaisdell Engine
1 Hamilton, 16" x 6'
1 LeBlonde Engine, 12" x 6'
2 Hendey Norton, 14" x 6'
1 Lehman, 18" x 6'
1 Hamilton, 18" x 6'
2 Monarch, 16" x 6'
1 Lodge & Shipley, 18" x 8'
1 Stark Bench, No. 3½

SHAPERS
1 Hendey Crank, 16"
2 Hendey Crank, 20"
1 Gould & Eberhardt, 20"
1 Gould & Eberhardt

MILLING MACHINES
2 Cincinnati, No. 3
1 Knight

DRILLING MACHINES
1 Knight No. 2
1 Barnes No. 2, 26"
1 Barnes 34" Upright
1 American No. 3 Sensitive Radial

PLANERS
1 Cincinnati, 36" x 36" x 10'
1 Lodge & Shipley, 24" x 24" x 6'

GRINDERS
1 Plane Dry Grinder
1 Whitney Wet Tool Grinder, 2½ x 18
1 Wilmarth & Norman Drill
1 Talf-Peirce Universal
1 Thompson Universal, 10" x 36"
1 Grindstone, 4" x 36"
1 Portable Electric Dumont
1 Reed No. 2 Surface
1 No. 1½ Cincinnati Univ. Tool and Cutter

FURNACES
1 W. S. Rockwell Brazing
1 Bethlehem Cyanide Pot
1 W. S. Rockwell Carbonizing
1 W. S. Rockwell Hardening
1 W. S. Rockwell Tempering Pot

MISCELLANEOUS
1 Connersville Blower
1 Stewart Blower
1 ¾" Oil Pump
1 2½" Oil Pump
Hardening Room Instruments
1 Bowser Oil Storage System
1 Racine Hack Saw
1 Power Hack Saw—Royal No. 5
1 No. 5 Niagara Punch Press
1 6" Belt Lacing Machine
1 Spring-Bench Straightening Press
1 Grenard Arbor Press No. 4

A large stock of tool, machine and high speed steel together with all other small tools and accessories required in high grade tool and die work.
Inspection of this material may be made and quotations on whole or part received from

W. K. COOPER, Assignee, Jamestown Die & Tool Corp., JAMESTOWN, N. Y.

FOR SALE
Vreeland 10-H.P. Gas Engine

Good condition. Occupies space about 4 feet by 8 feet. Suitable for small machine shop.

Edwin C. Bruen, Inc., 63 Barclay St. New York

Rebuilt and new electric motors, generators and transformers.

All standard makes, sold, bought and exchanged. Our rebuilt motors stand every test of new motors; $000 always in stock; send for stock list. Write what you want or have to sell.

FUERST-FRIEDMAN CO., Cleveland, Ohio

PLANER BARGAINS

36" x 12' Powell, single head, belt or with motor drive, like new.
36" x 12' Wheeler, two heads. Priced low.

MILES MACHINERY CO., Saginaw, Mich.

Surplus Machinery For Sale

We have the following for sale—

Acme Auto. Screw Machines
Cleveland Auto. Screw Machines
Lapointe Broaches
Natco and Gardam Multiple Spindle Drills
Upright Drills
Norton Cylindrical Grinders
Heald Internal Grinders
Potter & Johnston 5a and 6a
Acme Turret Lathes
Greenlee Turret Lathes
Engine Lathes
Milling Machines
Bardons & Oliver Hand Screw Machines
Foster Screw Machines
Pratt & Whitney Thread Millers

THE WILLYS-MORROW CO., Elmira, N. Y.

Practically New

30" x 24" x 12'
INGERSOLL Four Head
ADJUSTABLE RAIL
MILLING MACHINE

32" between housings
32" max. between horizontal spindle noses
20" min. between horizontal spindle noses
Approximate weight 27,400 lbs.
PRICE $5780.00

Condition Excellent
Exceptional Bargain

THE NEW BRITAIN MACHINE CO.
NEW BRITAIN, CONN.

FOR SALE

150 K.W. General Electric Dynamo, American Ball Engine, 225 R.P.M., 60 cycle, 2 phase, A.C. 220 volts, 420 amp. Now running. About seven years old—good as new. Duplicate shells for bearings. Separator, Throttle, etc. 100 K.W. Ames Engine, Westinghouse Generator, 270 R.P.M., 60 cycle, 2 phase, A.C., 220 volts, 280 amp. Ready to run. No repairs necessary. Bargain.

Address: **Jacob Miller's Sons Co.**
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1—No. 2 Cincinnati Vertical High Power Type Vertical Milling Machine, Table 47½" x 12", Feeds 28" x 12" x 14". Condition like new.....$1150
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Brighton Road at Penna. Ave.
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1—New 32 ft. Consolidated Vertical Boring and Turning Mill, "Betts type"

with all modern features. Machine has 24' table with steel table drive gear and pinion. Takes 12' 6" under tools, has 10' tool bar travel. Cross rail is heavy box section, 48" face and special clamping device.

Machine is now under construction and will be ready for shipment September, 1923.

For further information and price, address:

WESTINGHOUSE ELECTRIC & MFG. CO.
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Your Attention
Used Machine Tools

3A Warner & Swasey Universal Turret
24"x24' Lodge & Shipley (Late type) Q.C. Lathe With Oil Pan—same as new.
26"x24' Lodge Davis Lathe (Raised to 32")
30"x14' Lodge & Shipley (Late Type) Q.C. Lathe, 3 Step Cone, D.B. Gear
24"x12' Springfield S.Q. Change Lathe
5' American Plain Radial, S.P. Drive
6' American Plain Radial, S.P. Drive.
6' Fosdick Plain Radial, Cone Drive
3' American Sensitive Radial
24" x 6' Gray Planer
No. 3 Wilmarth & Morman Surface Grinder
Shapers, 16", 18", 20" and 24".
No. 4 Baker Keyseater 4½" capacity.
22" Libby Turret Lathe, S.P. Drive
200 other high grade tools to select from.

JONES MACHINE TOOL CO.
435 E. Pearl Street CINCINNATI, OHIO

FOR SALE

Billings & Spencer Board Drop Hammer, 800 lbs., Model D, New.
United Engineering High Speed Steam-Hydraulic Forging Press, 150-183 Tons Capacity, New.
NATIONAL TOOL CO., Cleveland, Ohio

Clear away your discarded machines and get back some of the money invested. Sell them through the GREEN SECTION. Write for advertising rates.

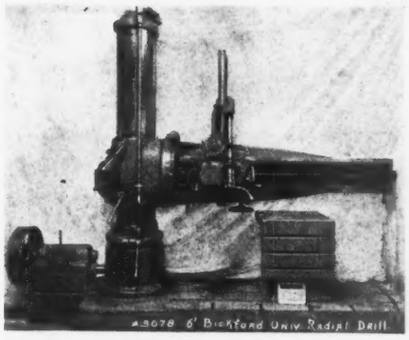
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18x50 Sterling plain cylindrical
Reed-Prentice vertical surface, 18"x78"
8x40 Morse plain cylindrical
No. 1 Brown & Sharpe Universal
Brown & Sharpe Cylinder Grinder
5x18 Ott, plain
No. 1½ Cincinnati Tool & Cutter Grinder
12x42 Landis, plain
10x72 Landis plain
No. 6 Bryant chucking
No. 20 Bryant chucking
No. 3 Wilmarth & Morman surface
No. 3 Wilmarth & Morman Surface Grinder
10x36 Thompson Universal Diamond wet tool
6x6 Ott internal

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Vonnegut Machinery Co.
25 W. South St., Indianapolis, Ind.

RADIAL DRILLS MULTIPLE SPINDLE



6' Bickford Radial Drill—Full Universal

Capacity, vertical range of arm, 42"; capacity, horizontal range of hd., 50"; greatest distance under spindle, 66"; diameter of column, 13".

This machine has been thoroughly rebuilt. It is a tool you would be proud to have in your shop.

PRICE f.o.b. Bpt. - $850.00

2½' Bickford Plain Radial Drill. Quick change..... $600.00
4' Hammond Sensitive Radial Drill, brand new..... 450.00

MULTIPLE SPINDLE DRILLS

No. 25 Natco High Speed Multi Drill. Rectangular Head. Arranged for 20 spindles. Equipped with 8..... 475.00
No. 12 Pratt & Whitney Multi Spindle Drill. Arranged for 12 spindles, equipped with 10. Price..... 475.00
2 No. 13 Natco Multiple Spindle Drills. Rectangular Head. Arranged for 20 spindles, equipped with 8. Price..... 850.00
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LUCAS MACHINERY SERVICE
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1—**Corliss Steam Engine**—11" bore, 30" stroke. Rated at 50 H.P. at 90 lbs. initial pressure. Built by the W. A. Harris Steam Engine Co.

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2—Steam driven Air Compressors.

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Millers Falls, Mass.

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USED TOOLS

A-1 Condition

1—12" x 6' Reed Lathe.
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1—24" Fay & Scott Pattern Makers' Lathe.
1—1 Spindle Allen B.B. Drill.
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1—25-in. Snyder Sliding Head Drill, Tap Attach.
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1—No. 3 Foster Universal Turret Brass Lathe, Friction Head, A.C. W.F.
1—No. 1 Kempsmith Plain Miller.
1—No. 3 Brown & Sharpe Plain Miller.
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Two Stage No. T-10, 100 lb. Capacity 300 cu. ft. per min.

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5—No. 55—Capacity 1⅝"
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In good running condition.
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3¼" single spindle Gridley Automatics.
Reed-Prentice Co. Lathes—14" x 5'4" bed, 23½" between centers, special cross slide, equipped with Hannifin Air Chucks.
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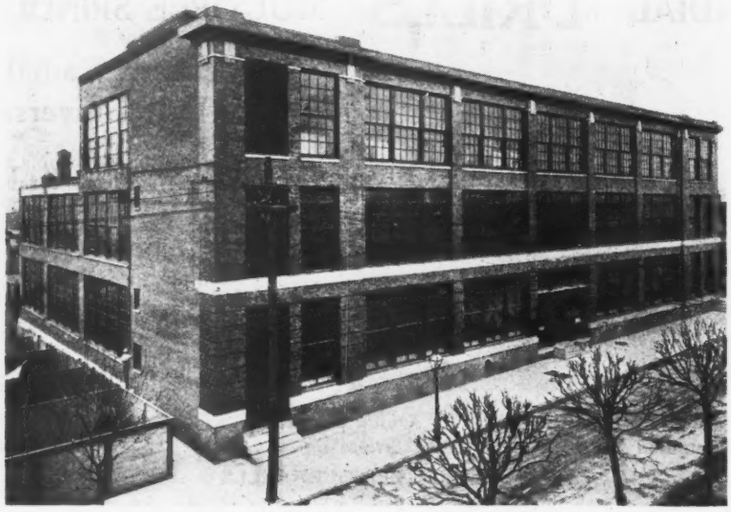
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1—32" x 8' Lathe and Morse
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1—21"x10' Lathe and Morse engine.

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MACHINERY'S Green Section Inquiry Department

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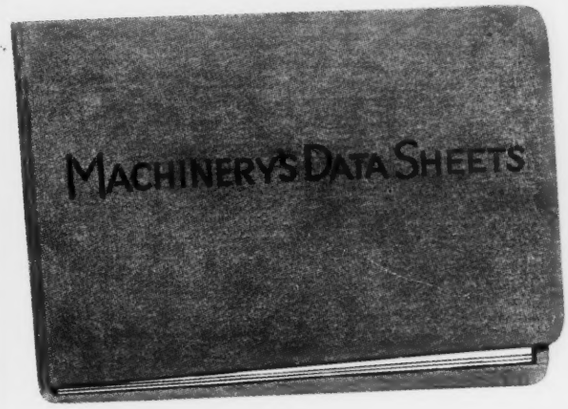
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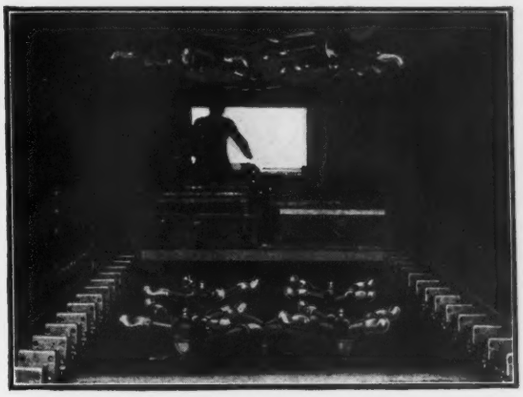


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This principle makes metal-cleaning easy

THE remarkable cleaning efficiency of the Double Revolving Wash is shown by the work Crescent Metal Cleaning Machines are doing for *Yale & Towne Mfg. Co., Stamford, Conn.* Here Crescents have been used for years to clean tripoli from brass lock parts.

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Westinghouse, General Electric, Ford Motor Co. and hundreds of plants of *every* size, in every branch of the metal working industry, are getting better results with Crescents, at an average saving of 50% to 80% in labor costs.

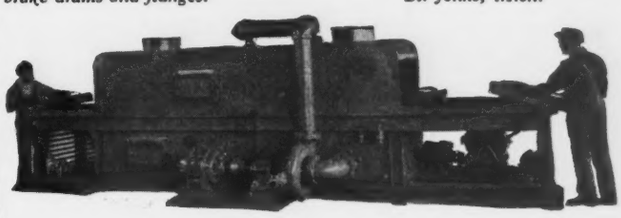
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"Washing Metals by Machinery"

CRESCENT WASHING MACHINE CO.
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Crescent
WASHING MACHINES
for Cleaning Metals

Crescent Metal Cleaning Machine for cleaning brake drums and flanges.

Built specially for Hayes Motor Truck Wheel Co., St. Johns, Mich.



BRUBAKER



Spindle Staybolt Taps

Fill the Bill in the Railroad Shop



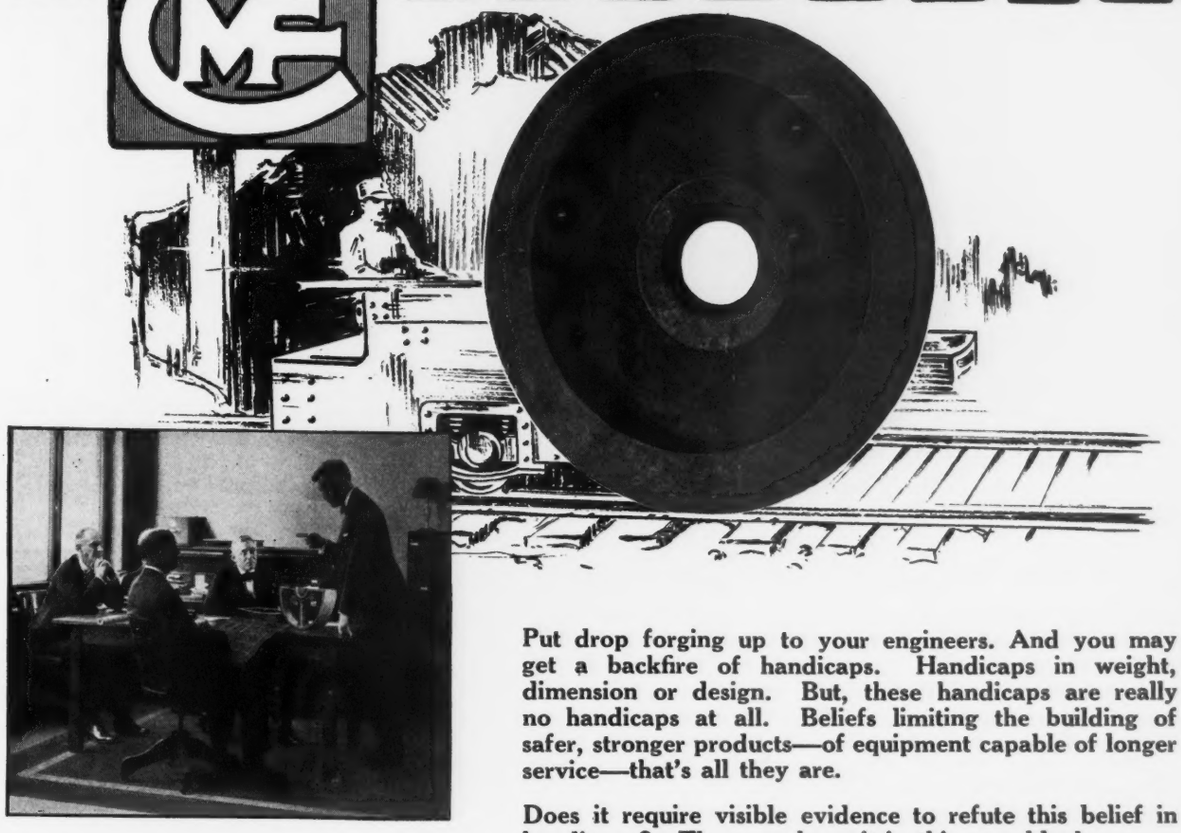
Railroad work is strenuous and tools that come up to the mark must be of a quality distinctly above the average. Retapping staybolt holes from inside the firebox of the locomotive is a tough job that can be most efficiently performed with the Brubaker Tool designed for this work.

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Two years co-operating with manufacturers in developing the qualities of their products by drop forged parts have given Champion Engineers a well rounded fund of experience on which to draw in working out your problems. They have come through in fifty odd cases. And their cooperation is yours at any time at your factory. Make your need known to us.

Put drop forging up to your engineers. And you may get a backfire of handicaps. Handicaps in weight, dimension or design. But, these handicaps are really no handicaps at all. Beliefs limiting the building of safer, stronger products—of equipment capable of longer service—that's all they are.

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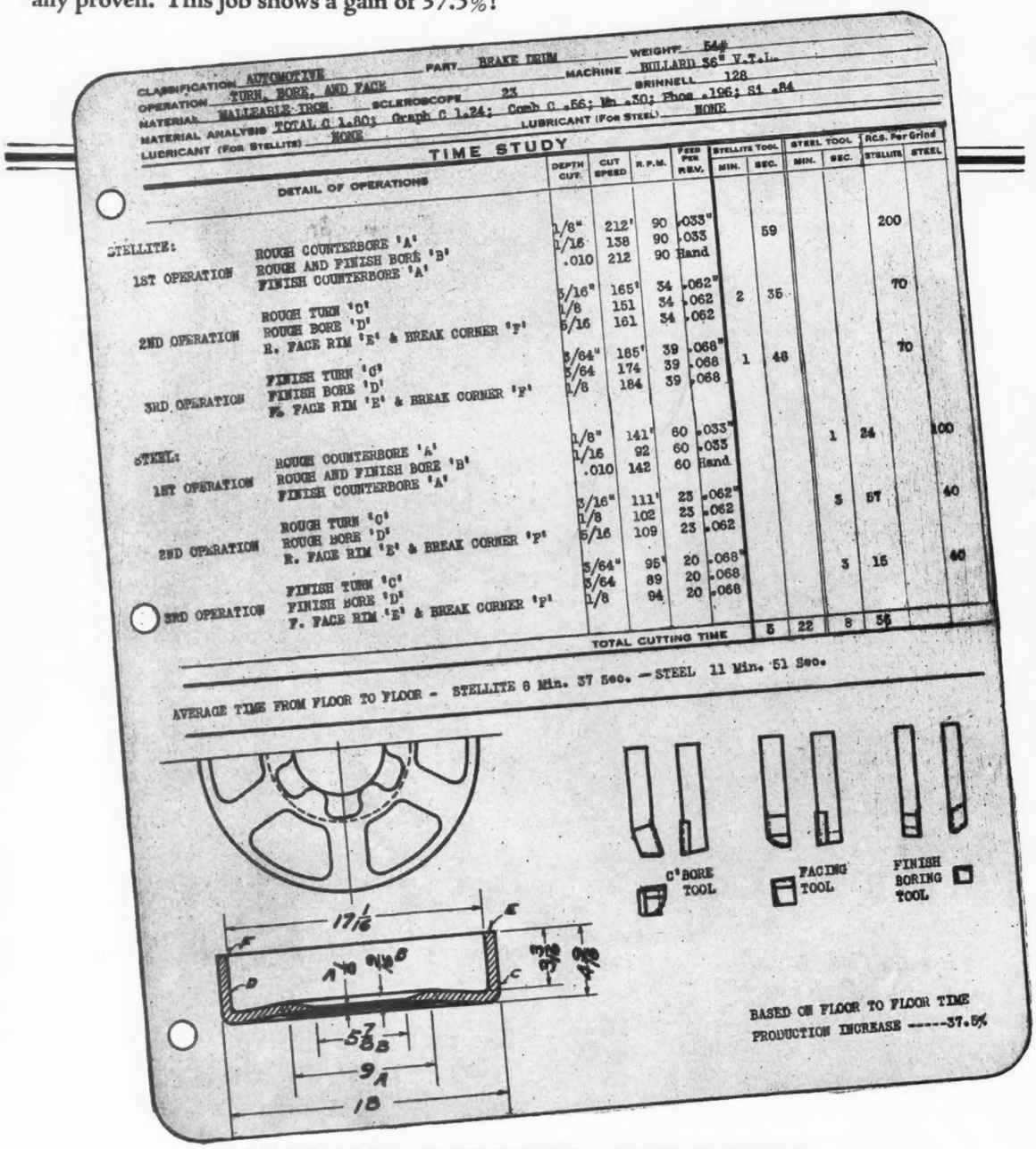
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CUTTING TOOLS

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You Can Cut Costs and Increase Drill Press Production If You Use

McCrosky WIZARD Chucks and Collets



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Branches in Boston, New York, Cleveland, Detroit, Chicago, San Francisco
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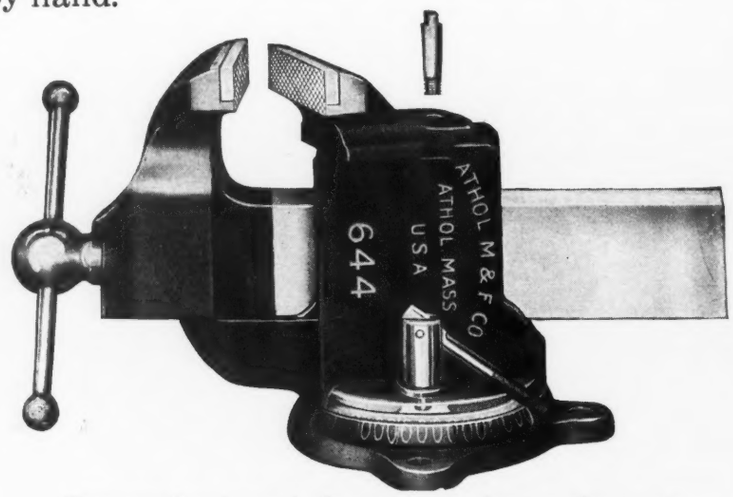
A Vise for Tapered, Round or Odd Shaped Work

This *Athol-Starrett* is the vise to hold odd shaped work securely, in any position; with no possibility of a slip.

The *swivel base* is equipped with a *positive* lock which cannot be slipped after clamp nut is tightened by hand.

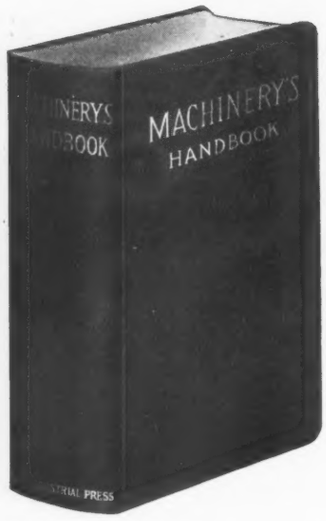
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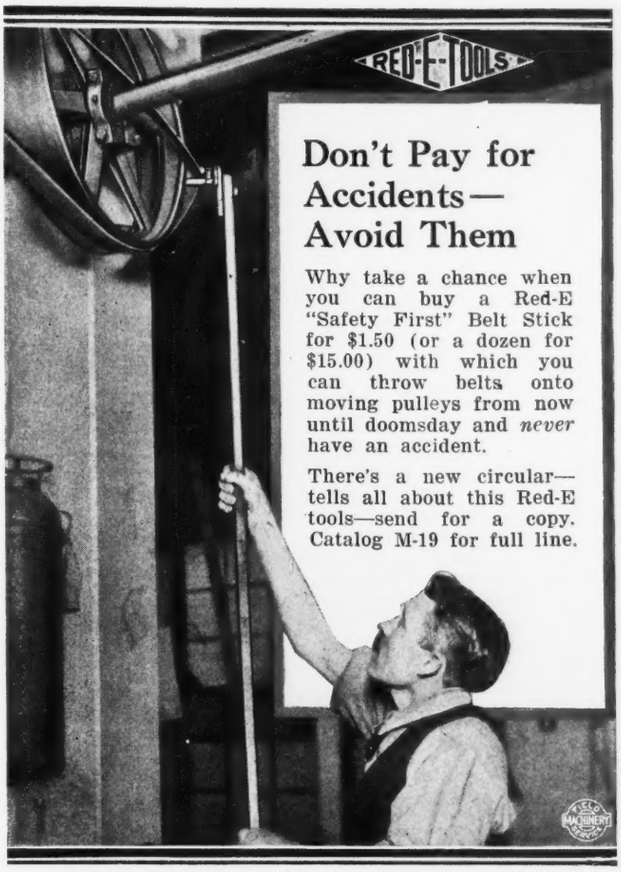
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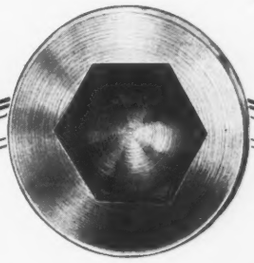
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The cold-drawn sockets *stand the strain* of the tightest set-ups.

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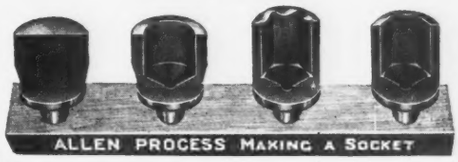
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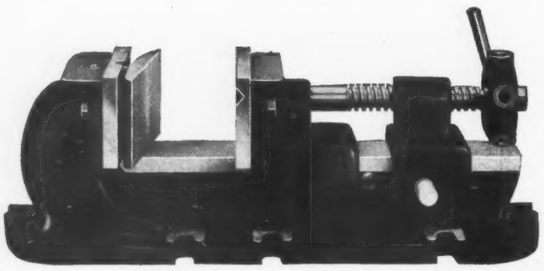
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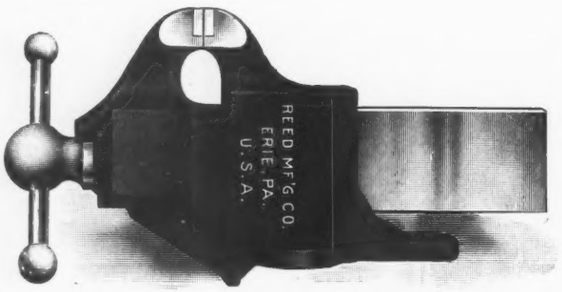
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It behooves the plant executive to see that each worker who needs to use a vise (only occasionally) has one right at hand and doesn't have to cross the shop or wait while another finishes using the one he wants to use.

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A "BEST SELLER"

Set MTT Microgages $75.00

SIZES			
0.1001	0.101	0.110	0.100
0.1002	0.102	0.120	0.200
0.1003	0.103	0.130	0.300
0.1004	0.104	0.140	0.500
0.1005	0.105	0.150	1.000
0.1006	0.106	0.160	2.000
0.1007	0.107	0.170	3.000
0.1008	0.108	0.180	6.000
0.1009	0.109	0.190	



MICROGAGES—The high quality every-day gage blocks

Use Set MTT and preserve your reference blocks.

You will like these cylindrical shaped gage blocks. They outwear rectangular gages, and are guaranteed for accuracy and permanency.

Have you Catalog No. 25, telling about Van Keuren Light Wave Outfits, Reference Gages, Microgages, Plug Gages, Thread Measuring Wires, and Lapped Surface Plates?

THE VAN KEUREN CO., 362 Cambridge St., Allston, Boston, Mass.



STEEL STAMPS

Send your Inquiries and Orders to the Manufacturer
JAS. H. MATTHEWS & CO.
2266 Forbes Field Pittsburgh, Pa.

MATTHEWS

DRILL VISE



Three Sizes

With and Without Jig Attachments
Often used on miller, shaper or planer.

Send for circulars

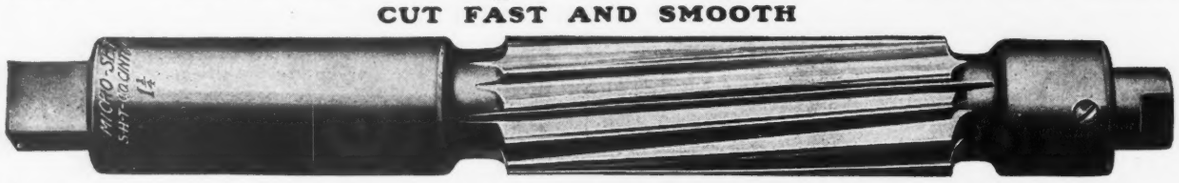
Other Tools
Drill Speeders
Knurl Holders

The Graham Mfg. Co.
Providence, R. I.

Great Britain — Burton, Griffiths & Co.
France, Italy, Switzerland, Spain and Holland, Fenwick Freres & Co.

The "Micro-Set" Expansion Spiral Hand Reamers

CUT FAST AND SMOOTH



They have improved expanding features. The body of expanding screw fits closely into pilot and always maintains alignment. They are true after expanding. Micrometer dial on end of pilot gives readings in ¼ thousandths. Large range of expansion. They will ream true holes in keyseated or oil-grooved holes. Made in spiral or straight flutes and special lengths. All sizes can be shipped from stock.

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F. E. Tighe Sales Company
2953 Montgomery Avenue, Detroit, Mich.

H. E. Barton Tool Company
104-106 South Jefferson St., Chicago, Ill.



HIGH LATROBE SPEED

Latrobe High Speed Drills

were the first practical combination forged and milled drills on the market.

Introduced over five years ago, their success was almost instantaneous with the result that this type of drill is being imitated and gradually adopted as standard by other leading drill manufacturers throughout the country.

Latrobe Drills have proven their worth and ultimate economy under all working conditions—they have passed the experimental stage—they are the kind your men should be using to obtain the best results.

LATROBE TOOL COMPANY
LATROBE, PENNA.

Latrobe DRILLS and REAMERS

V.H.Q.
(Vise Headquarters)

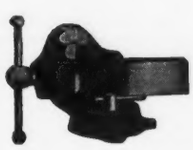
From—Yost Manufacturing Company

To—Purchasing agents everywhere

Subject—Yost Vises

Before choosing a vise, find out about Yost Vises. Ask any owner, user, or purchaser. He'll tell you there's no need to take advantage of the Yost replacement guarantee *but it always goes with a Yost product.*

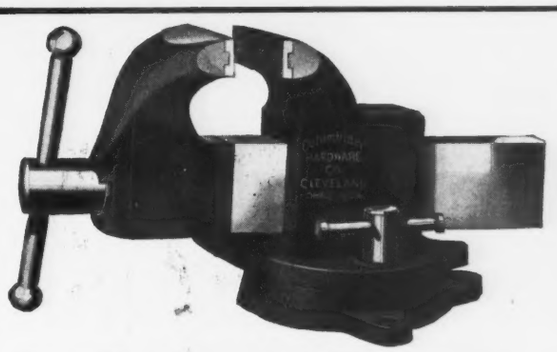
Yost products include Stationary, Adjustable Jaw, Swivel Base and Universal Double Swivel Vises, Dial Press Vise, Pipe Vises, Anvils, etc.



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Yost Manufacturing Company
MEADVILLE, PA.



Cut Equipment Expense with Columbian Vises

Columbian Sledge Tested Vises are practically indestructible. Made of malleable iron, they have twice the resistance of ordinary vises to heavy wear.

The separately tempered tool steel jaw faces are removable. When, after long, hard service, they finally do wear out, a new set—easy to replace—renews the vise.

—and the honestly built Columbian Vises are simple and accurate in operation.

Write for catalog on complete line.

The Columbian Hardware Co.
World's largest makers of Vises and Anvils
CLEVELAND, OHIO

COLUMBIAN
Sledge-Tested VISES

Opening on Machinery's Staff

A live job on MACHINERY'S Field Service Staff, offering a splendid future to a man with initiative and the ability to grow. The work is interesting and will appeal to any ambitious young man who likes to travel. It involves visiting the largest and most progressive machine shops, automobile plants and others, where machine tools of the latest type have been installed and the most up-to-date methods are employed, securing photographs and descriptive data on interesting engineering operations. ¶ Increases in compensation keep pace with increased ability to produce.

QUALIFICATIONS — Age —Between 25 and 30.

Education—High School, the equivalent or better.

Experience — Thorough knowledge of modern machine shop practice gained from several years of actual shop work. Some experience as a designing draftsman is desirable.

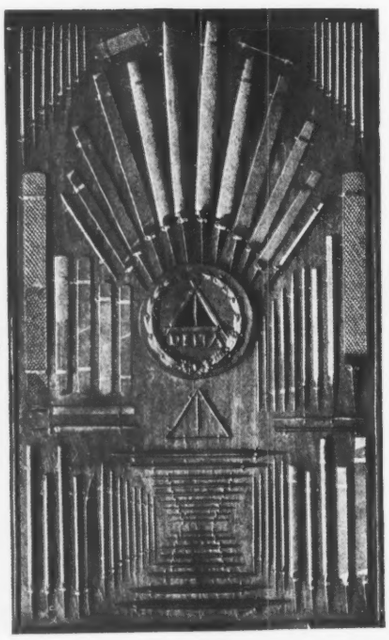
Personality—Bright, alert, good mixer, able to absorb new ideas quickly.

APPLICATIONS — Are invited from men whom this description fits. Write giving age, and details concerning education, experience and salary received in last position; also state whether married or single.

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Field Service Manager,
MACHINERY,
140 Lafayette Street,
New York.

THE WINNERS

Used in Every Shop Where Economy and Efficiency Are Practiced



TRADE MARK DELTA

FILES OF QUALITY

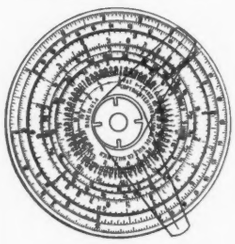
The File you will eventually use—as perfect as will and skill can make—clean, strong, sharp teeth

DELTA FILE WORKS

PHILADELPHIA, U. S. A.

Used in Every Shop Where Economy and Efficiency are Practiced

Midget Combination Slide Rule



(Patented 1-17-22)

Enables you to add, subtract, multiply and divide any combination of whole, fractional, decimal or mixed numbers and to get any root of any quantity.

Diameter 4"; price $1.50 (with instruction book) —leather case 50c extra.

Send for it, our "money back" guarantee insures your satisfaction.

Agents wanted in every Shop and Drafting-room. Liberal commission allowed.

GILSON SLIDE RULE CO., 22 Mill Street, NILES, MICH.

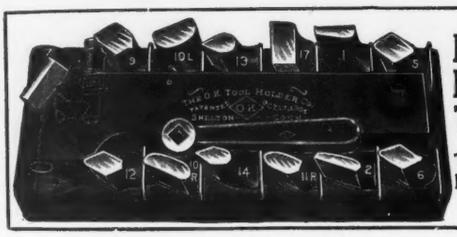
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Alloy steel shanks of high tensile strength, high speed steel cutting barrels joined by a special Alvord process that makes them integral.

Alvord Products include the right tool, the right steel for every class of work. Get details of the line.

ALVORD REAMER & TOOL CO.

MILLERSBURG PENNSYLVANIA



LATHE and PLANER TOOLS

THEO.K.TOOL HOLDER CO.

Shelton, Conn.

CLASSIFIED ADVERTISEMENTS

SITUATIONS, HELP WANTED, FOR SALE, ETC.

Advertisements in this section, 25 cents a line, seven words to a line—minimum, $1.50. The money should be sent with the order. Answers addressed to our care will be forwarded. Original letters of recommendation should not be enclosed to unknown correspondents.

HELP WANTED

WE DESIRE THE SERVICES OF HIGH-GRADE SALESMEN, thoroughly familiar with power presses as used by producers of drawn metal work. State experience in detail. See display advertisement. R. D. KING, Chicago, Ill.

WANTED SALESMEN—We have a side line for men well acquainted with selling mechanical instruments. Can build up a good income calling on hardware and tool stores. SIMOND CO., P. O. Box 274, Detroit, Michigan.

SHOP REPRESENTATIVE WANTED in your city to sell K. T. W. TAPER CALIPERS and CLAMPS. You will find these ready sellers, and indispensable tools. Write for prices. Generous commission. KNAUEL TOOL WORKS, 210 5th Ave., Rock Island, Ill.

WE ARE IN NEED OF EXPERIENCED TOOL AND DIE MAKERS, lathe, milling machine, grinder, horizontal boring mill, planer and J & L operators with experience on accurate work. Guarantee steady employment. Give full particulars in first letter. COLUMBUS DIE, TOOL & MACHINE CO., Columbus, Ohio.

WANTED — FIRST-CLASS MACHINISTS on large and medium boring mills, planers, lathes and boring bars. Also experienced drill press hands. Also high-grade shop erecting men for Diesel oil engines. BUSCH-SULZER BROS. DIESEL ENGINE CO., 2nd and Utah Sts., St. Louis, Mo.

WANTED—MAN TO TAKE CHARGE OF TOOL-ROOM running from 25 to 35 men, in a factory making electrical wiring devices. Must have a thorough knowledge of dies for producing and keeping up small accurate sheet metal parts. In replying state fully, previous experience. Employment steady; good opportunity. Factory in Connecticut. Box 639, care MACHINERY, 148 Lafayette St., New York.

SITUATIONS WANTED

MECHANICAL ENGINEER with office in Philadelphia would act as Sales Agent or Representative for mechanical or electrical equipment. Box 637, care MACHINERY, 148 Lafayette St., New York.

POSITION WANTED as foreman in tool-room or machine shop by a man with thirteen years' experience in tool, die, gage, jig, fixture and machine shop practice. Can furnish best of references. Box 642, care MACHINERY, 148 Lafayette St., New York.

SITUATIONS WANTED

FOREMAN FOR MACHINE SHOP OR TOOL-ROOM—Practical man, technical knowledge, 18 years at trade, 10 years as foreman. Box 640, care MACHINERY, 148 Lafayette St., New York.

POSITION WANTED as superintendent or manager of medium-sized foundry and machine shop, or industrial plant, by Protestant, thirty years old, married. Several years practical experience, unquestionable character. Prefer New England, but will go anywhere. Available August 15. Box 641, care MACHINERY, 148 Lafayette St., New York.

DEVELOPMENT ENGINEER, M. E. Cornell, twenty years in investigation, design, manufacture, sales and installation. Experienced as executive in large and small organizations, foreign representative, government work, etc. Telegraph, telephone and submarine apparatus and construction, cable and other heavy machinery, automobiles and trucks. Box 638 care MACHINERY, 148 Lafayette St., New York.

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Salaried positions $2,500 to $25,000 upwards; executive, technical, administrative, engineering, manufacturing, professional, managing, financial, etc., all lines. If you are qualified, and receptive to tentative offers for a new connection, you are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions. A method is provided through which you may receive overtures in confidence, without jeopardizing present connections, and in a manner conforming strictly to professional ethics. Send name and address only: preliminary particulars will be sent without obligating or compromising you in any way. R. W. BIXBY, INC., 409 Lockwood Building, Buffalo, N. Y.

EXECUTIVES—Qualified men—Technical, Commercial or Manufacturing—seeking new positions find our effective and confidential service extremely satisfactory. Our Mr. H. H. Harrison can negotiate a suitable connection for you as he has done for thousands of others since 1909. Inquiries invited; confidence respected. THE NATIONAL BUSINESS BOURSE, INC., Confidential Negotiators, Association Building, Chicago.

PATENTS

PATENTS SECURED—C. L. PARKER, Ex-member Examining Corps, U. S. Patent Office. Instructions upon request. McGill Bldg., Washington, D. C.

PATENTS

INDUSTRIAL MACHINERY—Special and automatic. Design, patents, construction and tests in our own mechanical, electrical and chemical laboratories. Manufacturing processes developed. GENERAL ENGINEERING AND SUPPLY CO., 160 Fifth Ave., New York.

PATENTS—H. W. T. JENNER, patent attorney and mechanical expert, 622 F St., Washington, D. C. Established 1883. I make an examination and report if a patent can be had, and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions.

PATENT FOR SALE—The Ericksen Duplex Tool Holder, works on forward and return strokes of the shaper and planer, as described in a recent number of MACHINERY. IVAR ERICKSEN, Stierlin Machine & Die Works, 625 W. Jackson Blvd., Chicago.

CONTRACT WORK

WOOD TURNING—Special work by expert hand turners. Large or small quantities. Send us your inquiries. WOOD SPECIALTY COMPANY, Collins, O.

WANTED TO MANUFACTURE—A flexible shaft coupling, a machine shop tool or specialty, a power plant specialty or a motor driven medium weight machine or device of some kind. Will make on a royalty basis or purchase patent outright if satisfactory. W. H. NICHOLSON & COMPANY, 12 Oregon St., Wilkes-Barre, Pa.

FOR SALE

GOOD OPPORTUNITY—For young man with mechanical knowledge: well-established MANUFACTURING BUSINESS FOR SALE. Operated successfully for many years manufacturing gears, special machinery, etc. Owner retiring. Business in flourishing condition with orders and contracts sufficient to keep plant operating full for year or more. Value of assets about $500,000. Reasonable terms can be arranged. Box 621 care MACHINERY, 148 Lafayette St., New York.

MISCELLANEOUS

ADVERTISE YOUR WANTS:—The classified section of MACHINERY will put you in touch with the right people in the right way. If you need a situation—have a position to fill—want a specialty or something unusual—send your advertisement to MACHINERY's Classified Section.

PATENTS

C. L. PARKER
Ex-Member Examining Corps,
U. S. Patent Office

Attorney-at-Law and Solicitor of Patents

American and Foreign Patents secured. Searches made to determine patentability, validity and infringement.

Handbook for Inventors sent upon request.

McGill Building WASHINGTON, D. C.

PATENTS

Send sketch or model today for examination and report. *Record of Invention* blank on which to disclose your invention and NEW guide book, "*How to Obtain a Patent*," sent free. Promptness assured. Highest references. WRITE TODAY.

CLARENCE A. O'BRIEN, Registered Patent Lawyer
1033 Southern Building, Washington, D. C.

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CANADA: Toronto.
ARGENTINE REPUBLIC: Buenos Aires.

MACHINERY'S PRODUCT INDEX

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 295-296

ABRASIVE CLOTH AND PAPER
Carborundum Co., Niagara Falls, N. Y.

ACCUMULATORS, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Eng. Works, Charles F., 222 North Morgan St., Chicago.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

ACETYLENE APPARATUS
Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.

ACETYLENE, DISSOLVED
Air Reduction Sales Co., 342 Madison Ave., New York.
Prest-O-Lite Co., Inc., 30 E. 42d St., New York.

AIR HOISTS
See Hoists, Air.

ALLOYS, TUNGSTEN, URANIUM, VANADIUM, MOLYBDENUM, ALUMINUM, ETC.
Baush Machine Tool Co., Springfield, Mass.
Chesterfield Metal Co., Detroit, Mich.
Haynes Stellite Co., 30 E. 42d St., New York.
Ludlum Steel Co., Watervliet, N. Y.
Vanadium Alloys Steel Co., Latrobe, Pa.

ANGLE PLATES, UNIVERSAL
Boston Scale & Mch. Co., Roxbury, Mass.
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.

ANVILS
Columbian Hardware Co., Cleveland.
Yost Mfg. Co., Meadville, Pa.

ARBOR PRESSES
See Presses, Arbor.

ARBORS AND MANDRELS, EXPANDING
American Broach & Machine Co., Ann Arbor, Mich.
Eastern Tube & Tool Co., Brooklyn, New York.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Western Tool & Mfg. Co., Springfield, Ohio.
Whitman & Barnes Mfg. Co., Akron, O.

ARBORS AND MANDRELS, SOLID
Alvord Reamer & Tool Co., Millersburg, Pa.
American Broach & Mch Co., Ann Arbor, Mich.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass
Whitman & Barnes Mfg. Co., Akron, Ohio.

BABBITT
Ajax Metal Co., Philadelphia, Pa.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Doehler Die Casting Co., Brooklyn, N. Y
Hoyt Metal Co., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

BALANCING EQUIPMENT
Anderson Bros. Mfg. Co., Rockford, Illinois.
Divine Bros. Co., Utica, N. Y.
Norton Co., Worcester, Mass.
Rockford Tool Co., Rockford, Ill.

BALLS, BRASS, STEEL, ETC.
Abbott Ball Co., Elmwood, Hartford, Conn.
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Gwilliam Co., 253 West 58th St., New York.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.

BARS, BORING
See Boring Bars.

BEARINGS, BABBITT
Bunting Brass & Bronze Co., Toledo, Ohio.
Franklin Die-Casting Corp., Syracuse, N. Y.
Hoyt Metal Co., St. Louis Mo.
Johnson Bronze Co., New Castle, Pa.
Link-Belt Company, Chicago.
Royersford Fdry. & Machine Co., 54 North 5th St., Philadelphia.
Stewart Mfg. Corp., 4503 Fullerton Ave., Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, BALL
Aetna Ball Bearing Mfg. Co., 2737 High St., Chicago.
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Ct.
Bearings Co. of America, Lancaster, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Cresson-Morris Co., Philadelphia.
Fafnir Bearing Co., New Britain, Ct
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Gurney Ball Bearing Co., Jamestown, N. Y.
Gwilliam Co., 253 West 58th St., New York.
New Departure Mfg. Co., Bristol, Ct
Norma Co. of America, Long Island City, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.
U. S. Ball Bearing Mfg. Co., 4563 Palmer St., Chicago.

BEARINGS, BRONZE
Ajax Metal Co., Philadelphia.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Bunting Brass & Bronze Co., Toledo, Ohio.
Hoyt Metal Co., St. Louis, Mo.
Johnson Bronze Co., New Castle, Pa.

BEARINGS, LINESHAFT
Adamson Mch. Co., Akron, O.
Royersford Foundry & Mch. Co., 54 North 5th St., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, OILLESS
Arguto Oilless Bearing Co., 145 Berkley St., Wayne Junct'n, Philadelphia.

BEARINGS, ROLLER
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Ct.
Gwilliam Co., 253 West 58th St., New York.
Norma Co. of America, Long Island City, N. Y.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Royersford Foundry & Mch. Co., 54 North 5th St., Philadelphia.
Timken Roller Bearing Co., Canton, Ohio.

BEARINGS, SELF-OILING
Link-Belt Company, Chicago.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, THRUST
Aetna Ball Bearing Mfg. Co., 2737 High St., Chicago.
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Bearings Co. of America, Lancaster, Pa.
General Electric Co., Schenectady, N. Y.
Gwilliam Co., 253 West 58th St., New York.
Norma Co. of America, Long Island City, N. Y.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.

BELT CEMENT
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT CLAMPS
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

BELT DRESSING
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Dixon Crucible Co., Jos., Jersey City, N. J.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT FASTENERS, LEATHER
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT FASTENERS, METAL
Bristol Co., Waterbury, Conn.
Greene, Tweed & Co., 109 Duane St., New York.
Schieren Co., Charles A., 73 Ferry St., New York.

BELTING, LEATHER
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

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Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT LACING
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT SHIFTERS
Haskins Co., R. G., 516 W. Monroe St., Chicago.
Ready Tool Co., Bridgeport, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

BENCH LEGS
Brown & Sharpe Mfg. Co., Providence, R. I.
Lupton's Sons Co., David, Philadelphia.

BENDING MACHINES, ANGLE IRON
Buffalo Forge Co., Buffalo, N. Y.
Wickes Bros. Saginaw, Mich

BENDING MACHINES, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

BENDING MACHINES, PIPE
Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Machine Co., 3639 N Lawrence St., Philadelphia.
Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Underwood Corp., H. B., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

BLOCKS, CHAIN
See Hoists, etc.

BLOWERS
American Gas Furnace Co., Elizabeth, N. J.
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.
Westinghouse Elec. & Mfg. Co., East Pittsburg, Pa.

BLOWERS, POSITIVE PRESSURE
American Gas Furnace Co., Elizabeth, N. J.
Leiman Bros., 60-62 Lispenard St., New York.

BLUEPRINT DRYING MACHINES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

BLUEPRINT FILING CABINETS
See Cabinets, Filing.

BLUEPRINT MACHINES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.
Wickes Bros., Saginaw, Mich.

BLUEPRINT PAPER
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

BOILER TUBES
Chase Metal Works, Waterbury, Conn.
National Tube Co., Pittsburgh, Pa.
Ryerson & Sons, Joseph T., 2558 W. 16th St., Chicago.

BOLT AND NUT MACHINERY
Acme Machinery Co., Cleveland.
Ajax Mfg Co., Cleveland.
Landis Machine Co., Inc., Waynesboro, Pa.
National Acme Co., Cleveland.
National Machinery Co., Tiffin, O.

BOLTS AND NUTS
National Acme Co., Cleveland.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

BOOKS, TECHNICAL
Industrial Press, 148 Lafayette St., New York.
Wiley & Sons, Inc., John, 432 Fourth Ave., New York.

BOOSTERS
American Gas Furnace Co., Elizabeth, N. J.
Westinghouse Elec. & Mfg. Co., East Pittsburg, Pa.

BORING AND DRILLING MACHINES, VERTICAL
Baker Bros., Toledo, O.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Colburn Mch. Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Ferner Co., Roy Y., Washington, D. C.
Foote-Burt Co., Cleveland.
Gisholt Machine Co., 9 So Baldwin St., Madison, Wis.
Ingersoll Milling Mch. Co., Rockford, Ill.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
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Niles-Bement-Pond Co., 111 Broadway, New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago
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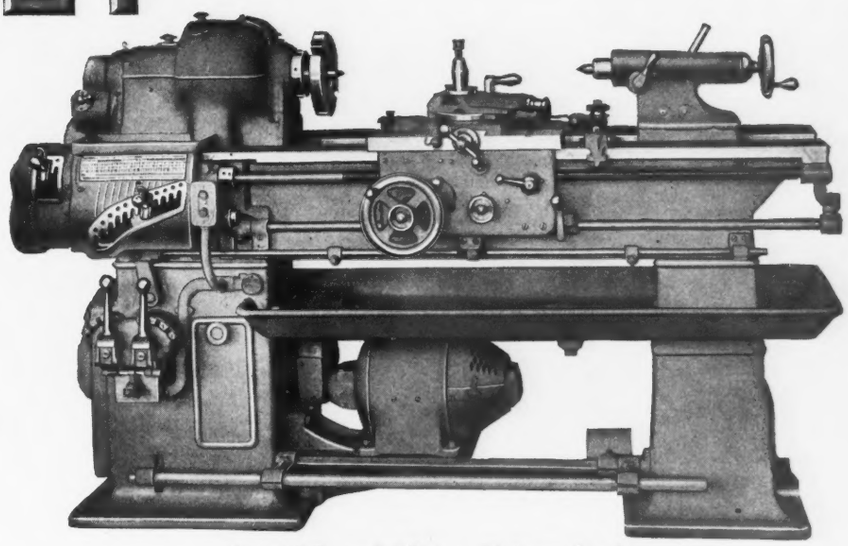
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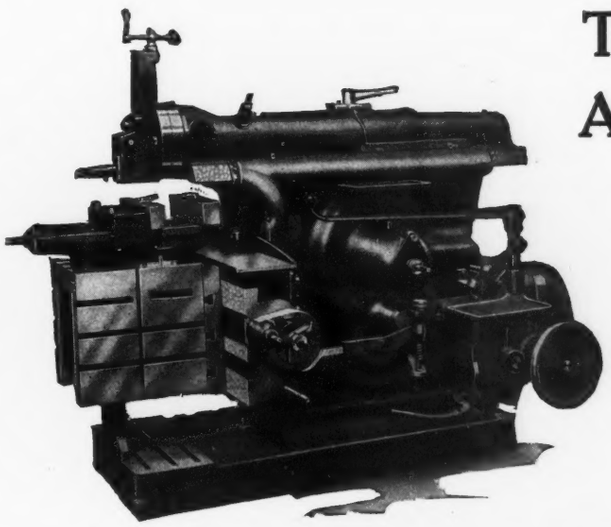


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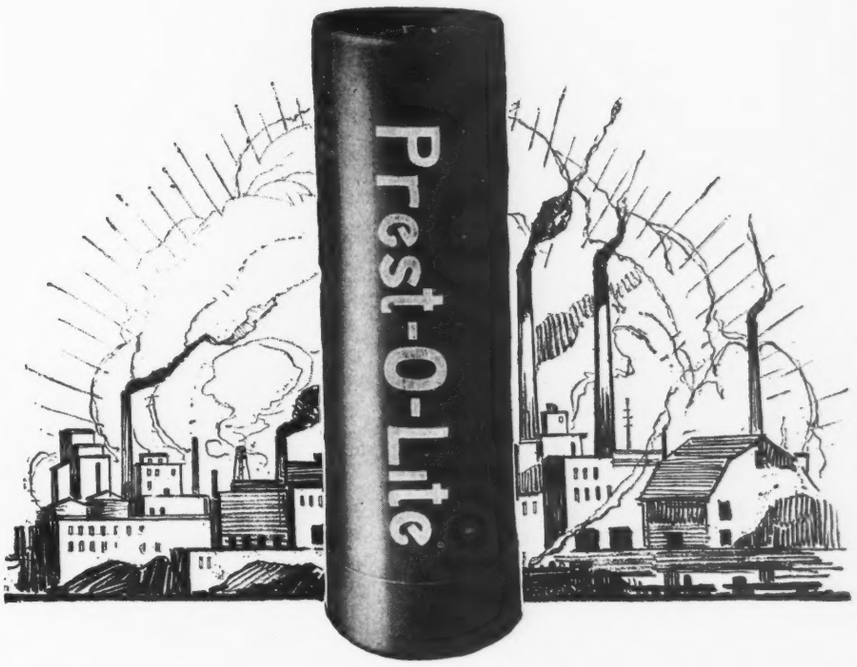
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Production Engineering Corp., Canastota, N. Y.
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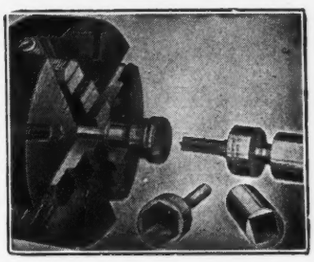


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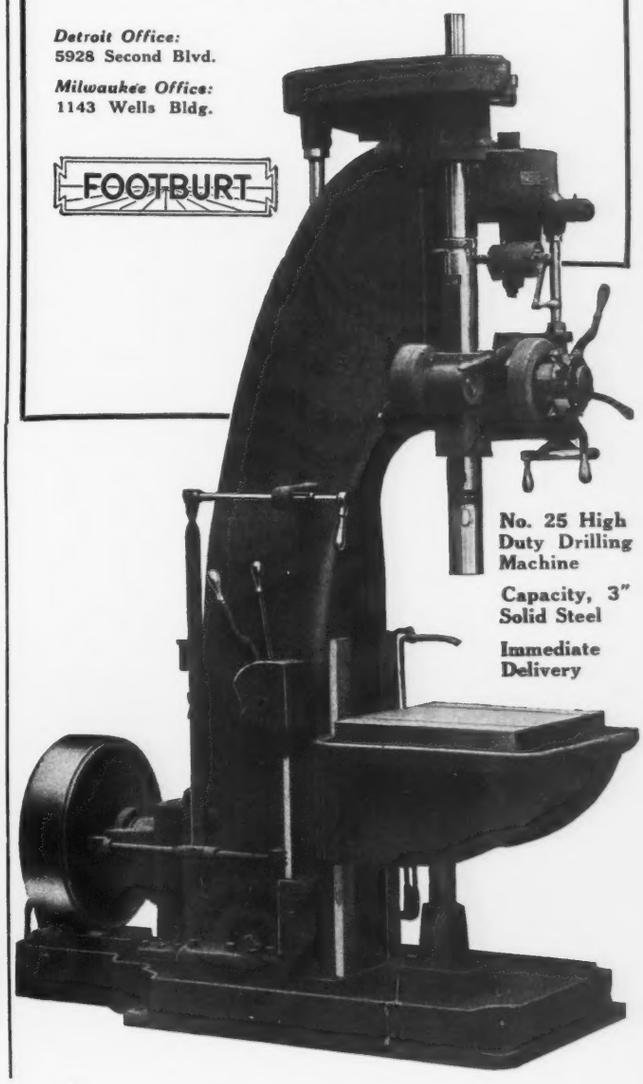
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Stow Mfg. Co., Binghamton, N. Y.
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Van Dorn Electric Tool Co., Cleveland.
Wisconsin Electric Co., Racine, Wis

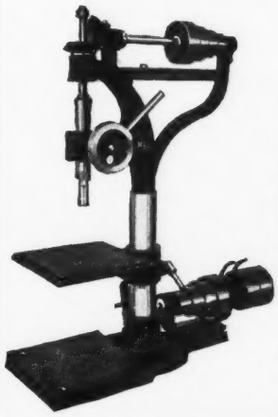
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Colburn Machine Tool Co., Cleveland.
Consolidated Machine Tool Corp. of America, 17 E. 42nd St., New York.
Foote-Burt Co., Cleveland.

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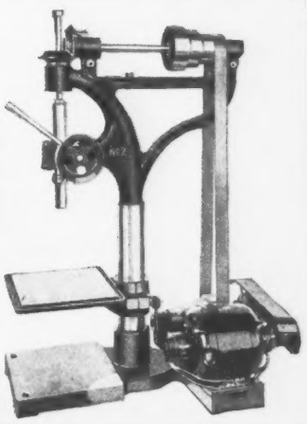


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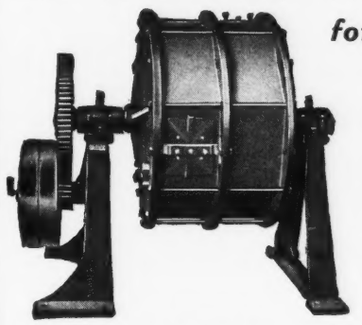
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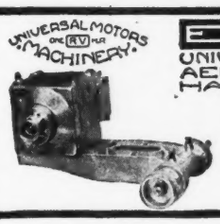
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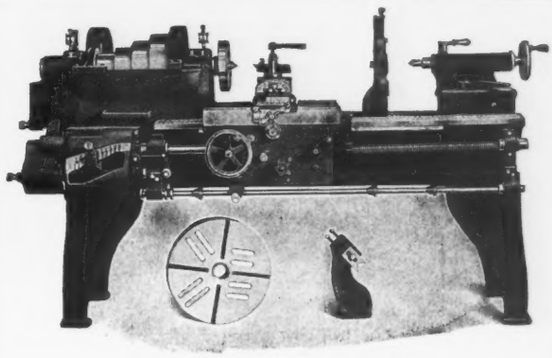
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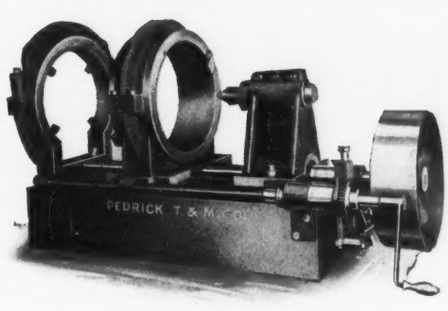
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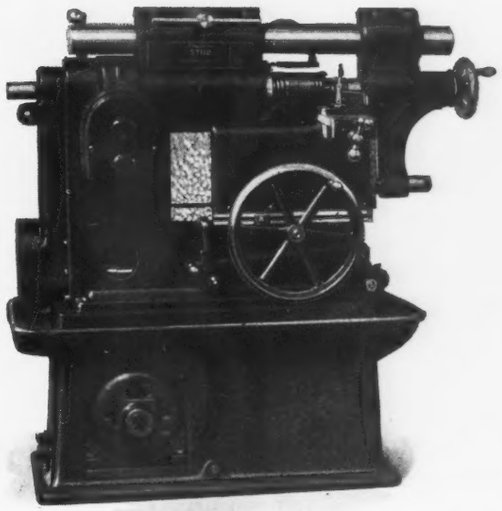
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Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

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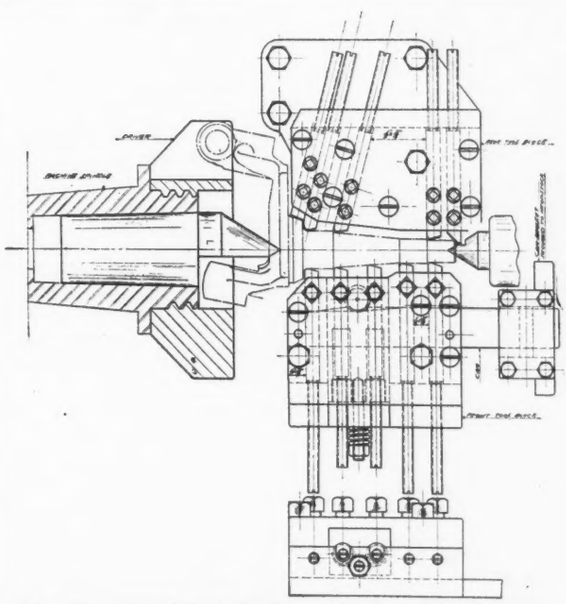
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These features add greatly to the productivity and range of the Stub Lathe—a remarkable tool for the manufacture of such work as pistons, wheel hubs, gear blanks, ball joints, steering knuckles, etc. Send for the circular.



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Newark Gear Cutting Machine Co., Newark, N. J.
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Toledo Mch. & Tool Co., Toledo, O.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Fawcus Machine Co., Pittsburgh.
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Horsburgh & Scott Co., Cleveland.
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Continental Fibre Co., Newark, Del.
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Formica Insulation Co., Cincinnati.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Simonds Mfg. Co., Pittsburgh.
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Grant Gear Works, Inc., Boston.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
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James Mfg. Co., D. O., 1120 West Monroe St., Chicago.
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Meachem Gear Corp., Syracuse, N. Y.
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Cleveland Worm & Gear Co., Cleveland.
Connecticut Gears, Inc., Waterbury, Conn.
Diefendorf Gear Corp., Syracuse, N. Y.
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Harrington, Son & Co., Inc., Edwin, Philadelphia.
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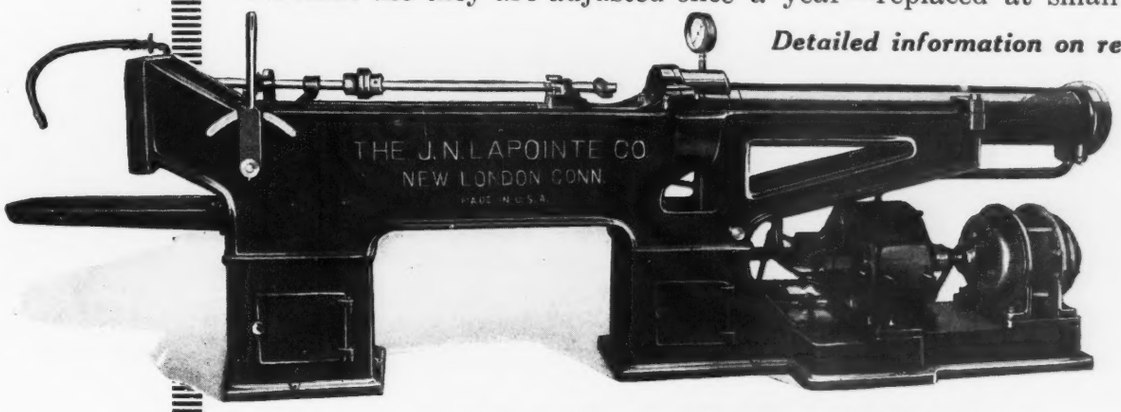
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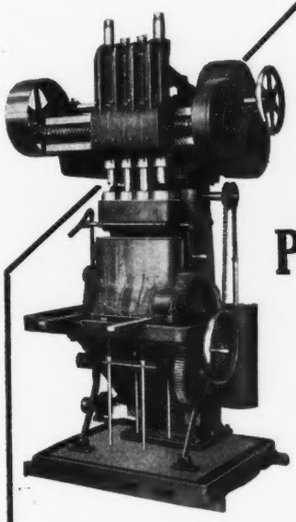
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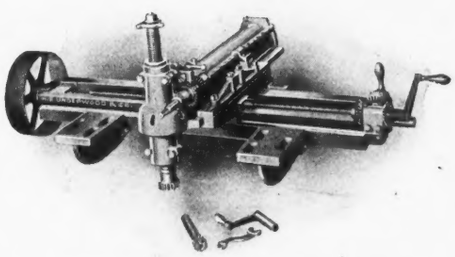
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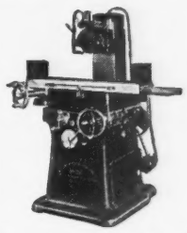
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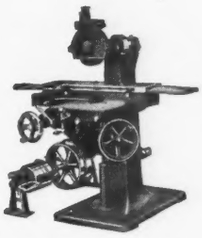
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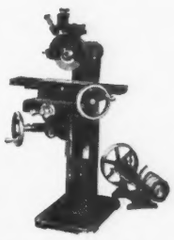
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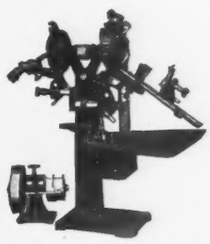
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Pratt & Whitney Co., Hartford, Conn.
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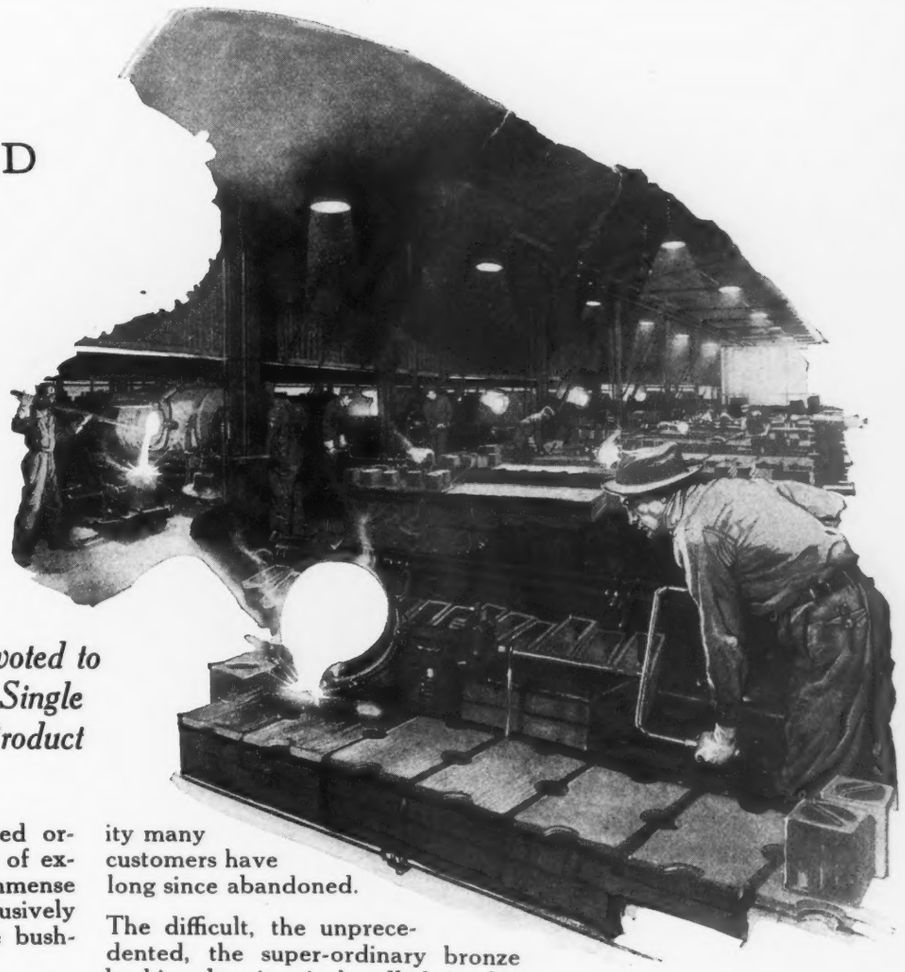
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Betts Machine Co., Rochester, N. Y.
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Liberty Mch. Tool Co., Hamilton, O.
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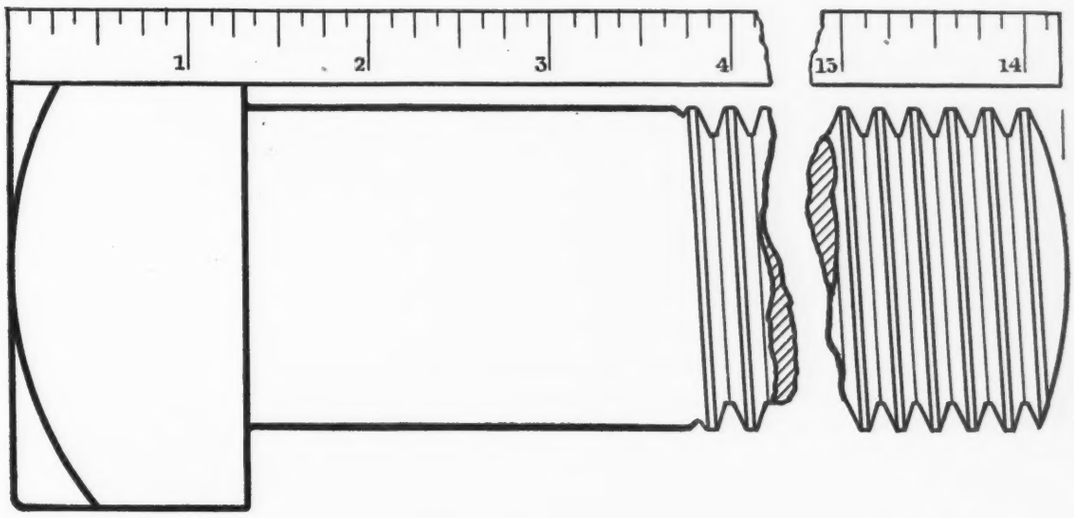
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Williams, White & Co., Moline, Ill.

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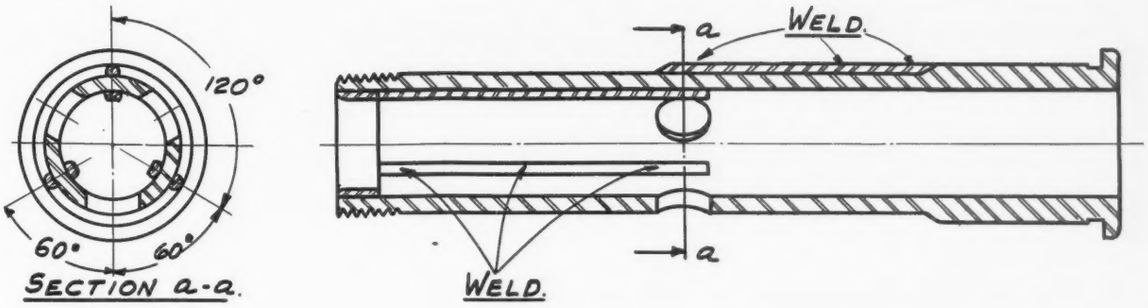
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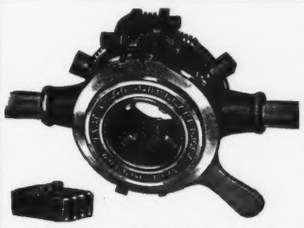
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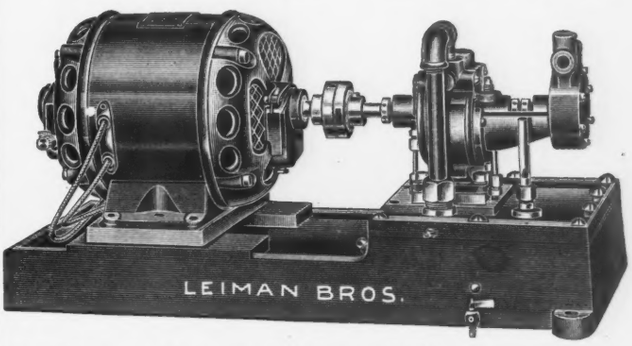
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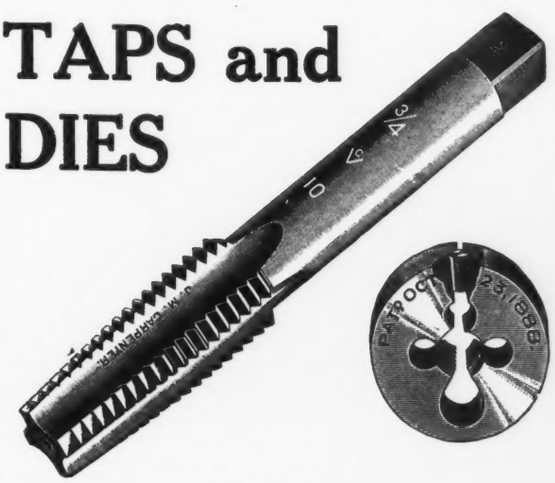
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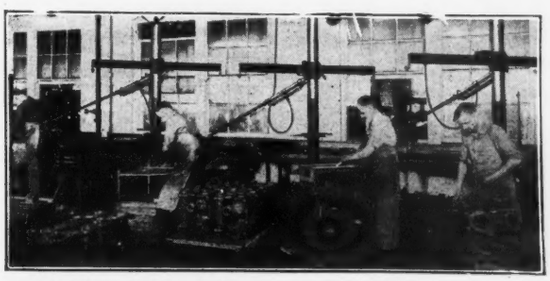
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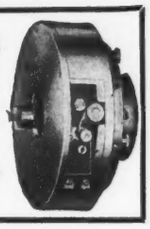
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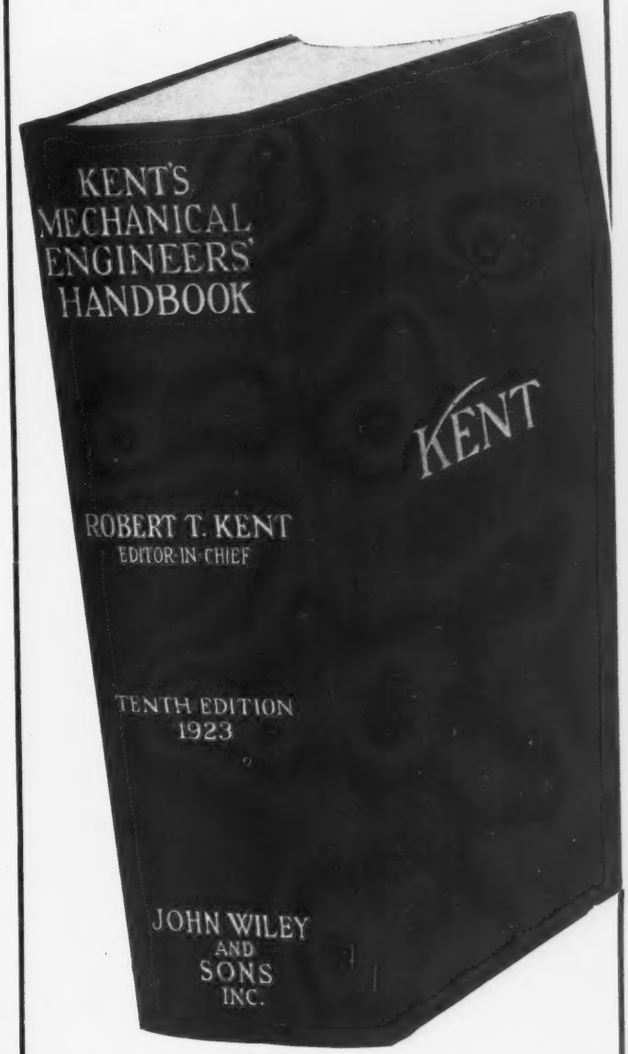
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Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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Meisselbach-Catucci Mfg. Co., Newark, N. J.

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Gray & Prior Machine Co., Hartford, Conn.

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Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
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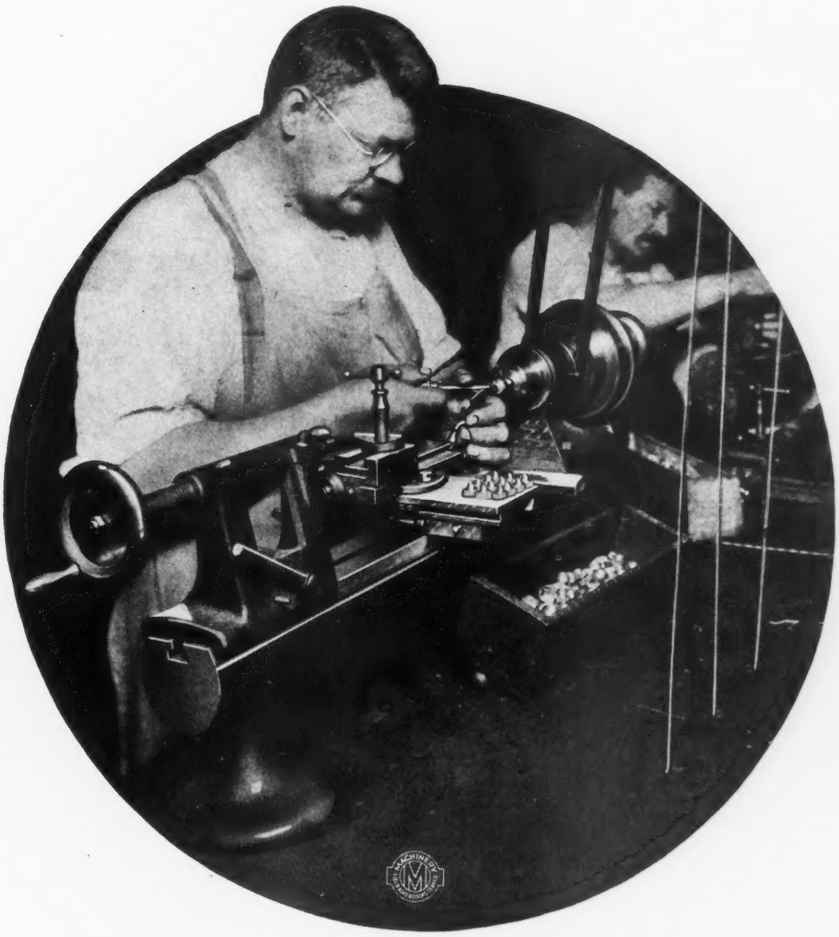
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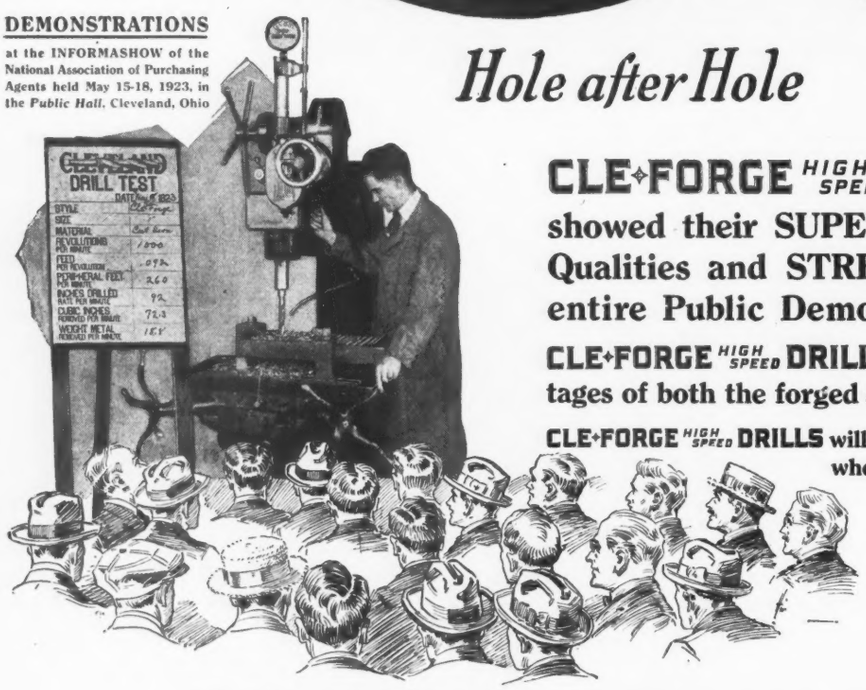
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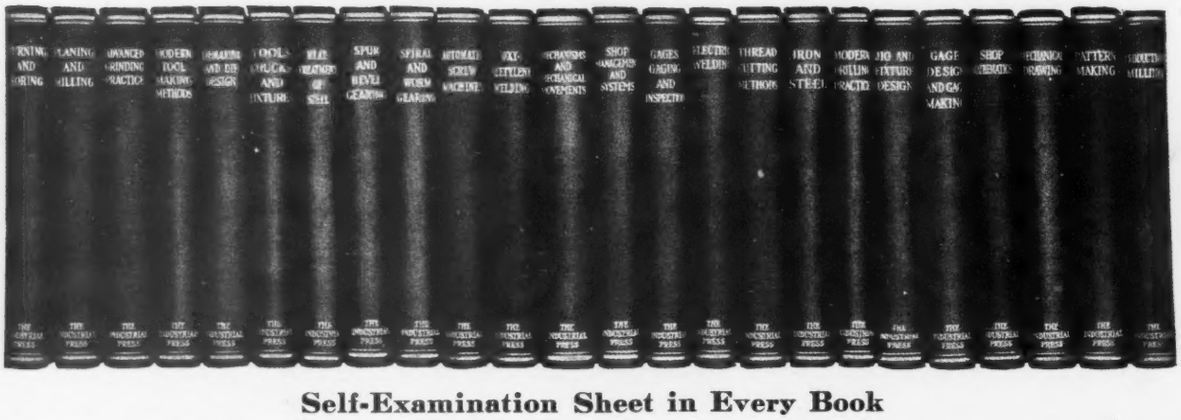
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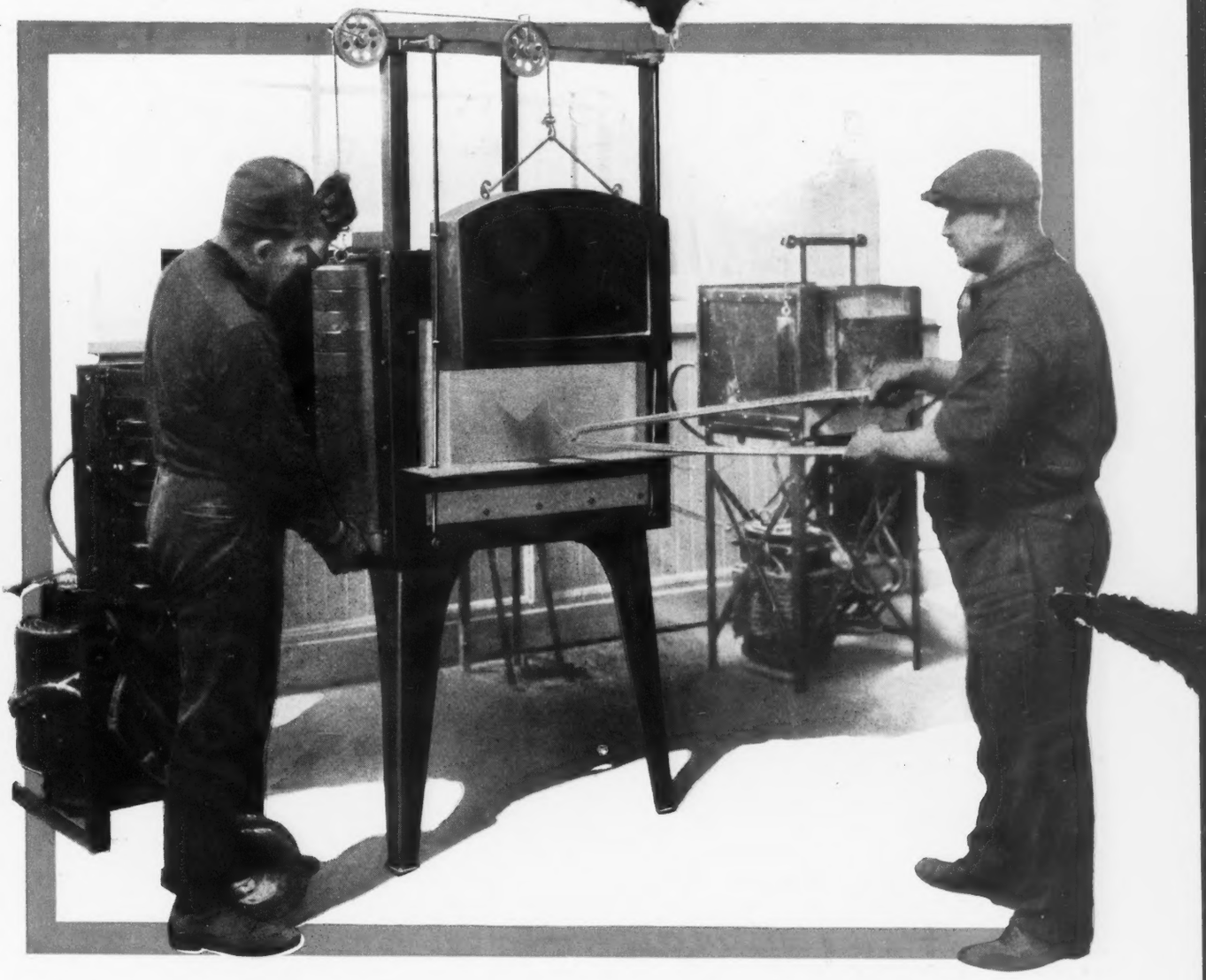
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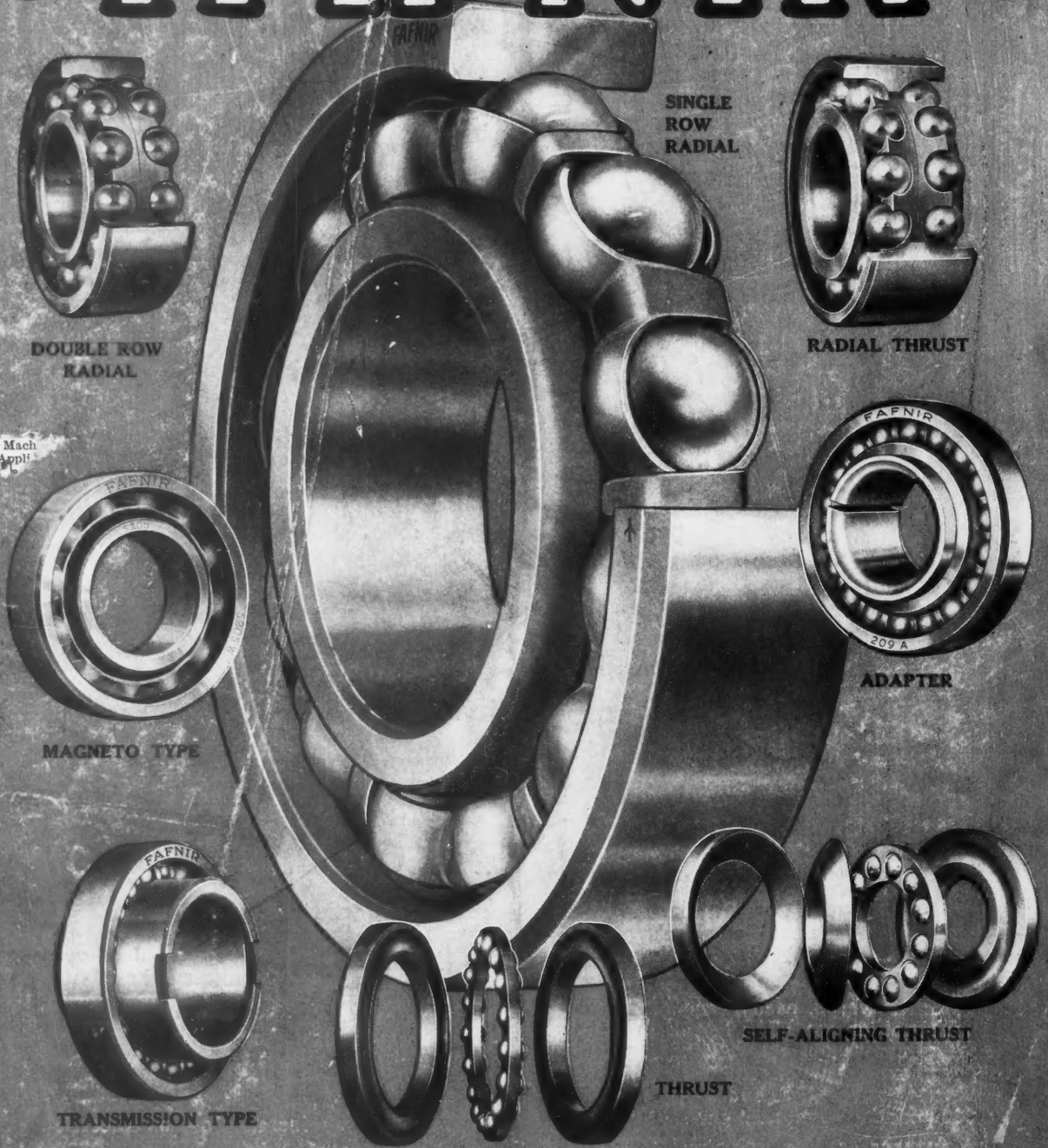
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